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THE TELEPHONIC CENTRAL OFFICE SYSTEM.

It is difficult to conceive of an invention more marvelous than that which enables persons to converse with each other without regard to the space that separates them; and it is not only wonderful, but deeply interesting to the student of science, as it involves several of the most prominent physical discoveries of modern times. It is a monument of persevering and difficult study and experiment. From being a mere scientific curiosity, universally believed to be of no practical value, it has now become an important factor in the daily business and social life of this and other large cities.

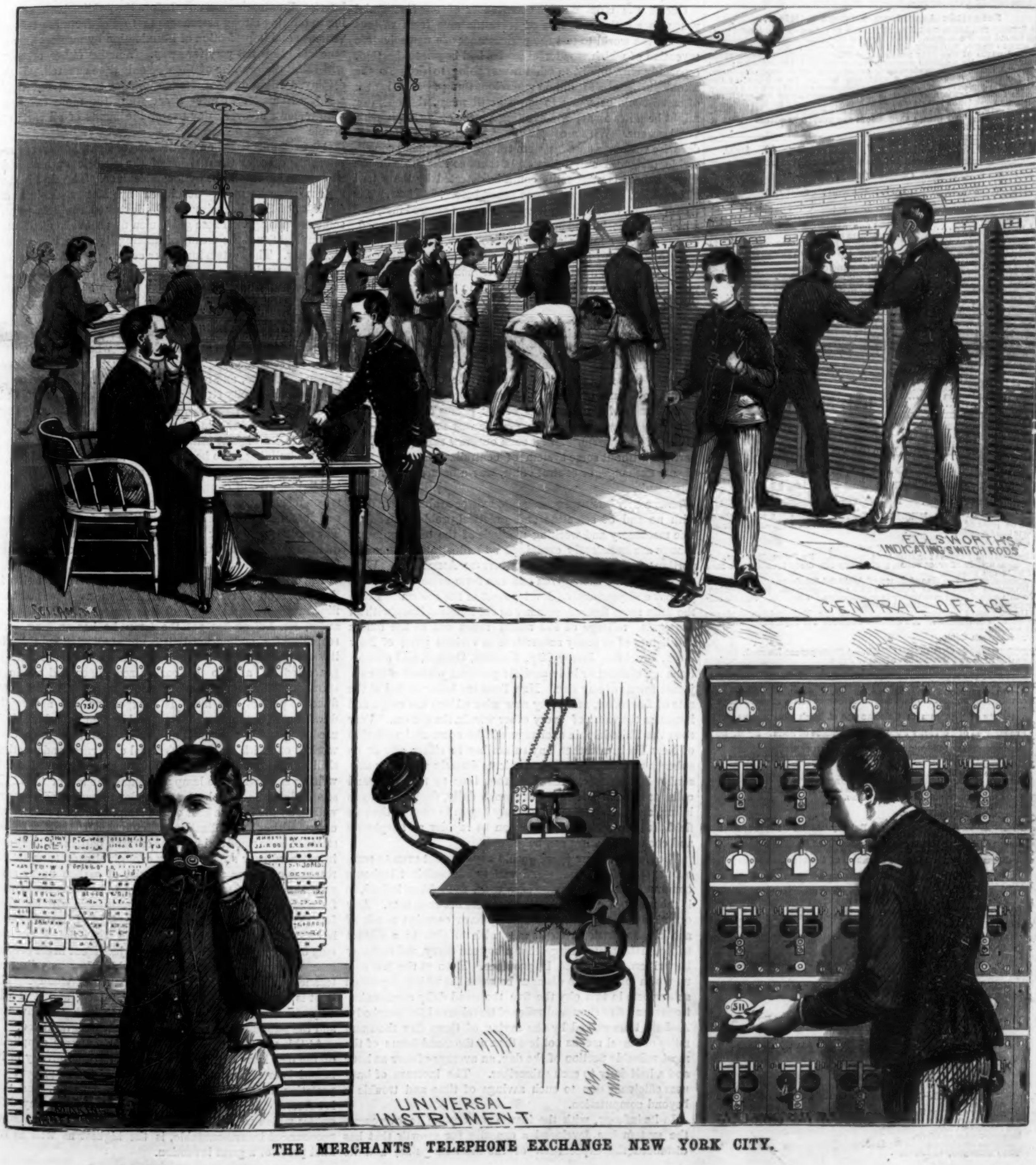
The uses to which the telephone is already applied, its future and its possible applications, will be considered in another place, the object of the present article being to afford the general reader an idea of the details of the arrangement and working of the central office system, which increases the usefulness of the telephone manyfold.

We have chosen for illustration as an example of this system in its perfected form, the Merchants' Telephone Exchange, located at 198 Broadway, and controlled by the Gold and Stock Telegraph Company of this city.

The telephone shown in the lower central figure in the accompanying engraving scarcely needs description, its construction and the details of its operation having been repeatedly described in these columns. In brief, the adjustable arm carries an Edison carbon button transmitter, connected with the primary wire of an induction coil concealed beneath the desk. A receiving telephone, which is connected with the line wire, hangs upon a switch at the opposite end of the desk. Removing and replacing the telephone operates the switch. Above the desk there is an ordinary single-stroke electric bell, and below it are two cells of Leclanché battery.

This telephone is one of many, each of which is connected by a single wire with the central office, the interior of which

[Continued on page 21.]



THE MERCHANTS' TELEPHONE EXCHANGE NEW YORK CITY.

Scientific American.

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NEW YORK, SATURDAY, JANUARY 10, 1880.

Contents.

(Illustrated articles are marked with an asterisk.)

TABLE OF CONTENTS OF

THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 210,

For the Week ending January 10, 1880.

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THE FUTURE OF THE TELEPHONE.

There is nothing more characteristic of the present age than the avidity with which it seizes upon and puts to practical use the discoveries of science and the infinite marvels of invention. To-day the experimental student wrests from the secret treasures of the universe a new truth, a new law, a new manifestation of force. To-morrow a countless host of printing presses spread a knowledge of the discovery to the earth's remotest bounds. Directly it is made a working factor in the world's best thought and action; in a little while some practical mind puts the harness of utility upon the new truth, and straightway the world is the richer by another useful invention. What would formerly have taken centuries to accomplish—or what the most fearless minds would scarcely have dared to dream of undertaking—is now done in a day. The invention is achieved, and finds a world prepared to receive it with gladness, even though its adoption should necessitate many and radical changes in the whole range of national and social customs. It took the steam engine centuries to pass from the stage of science unapplied to that of practical utility. The telegraph was not so many years in rising from the level of scientific experiment to that of a useful factor in the daily affairs of nations. What the telegraph accomplished in years the telephone has done in months. One year it was a scientific toy, with infinite possibilities of practical use; the next it was the basis of a system of communication the most rapidly expanding, intricate, and convenient that the world has known.

One of the most notable occurrences of our Centennial year was a little gathering of scientific men from various parts of the world to test the performance of a new scientific invention of which wonderful stories had begun to be told, especially with regard to what it was going to do. To the astonishment of all it did do marvelous things. A little disk of metal could be made to speak; still more, the operator might be miles away, and exerting power only through his vocal organs. With a couple of magnetic cups and a slender wire spoken messages were transmitted through considerable distances and delivered in tones so like those of the speaker that his personality could be detected by the sound of his voice, if it had ever been heard before. Though far from perfect, the speaking telephone was an assured fact, and a new era in social and business communication had dawned. Scores of active minds at once set to work upon the problems to which the telephone gave rise, and hundreds soon joined them. In a little while the telephone in various forms was in the hands of progressive men in every part of the world.

It was tried as a means of uniting more or less widely detached portions of business houses, as the salesroom and the manufactory, and proved a great success. As a means of social and professional communication it was equally satisfactory. The next step was to form little clusters of telephonic communicants; the wider and more varied the business callings of the members of the group and the more numerous its membership the greater was found to be the utility of the system. But it soon outgrew manageable proportions without some system of centralization. The telephonic exchange, or central office, was a natural and necessary result.

Thus a new business sprang into existence almost in a day, with no end of scientific and practical problems to solve. The machinery and working methods of the telephonic exchange are sufficiently explained and illustrated in another portion of this issue of the SCIENTIFIC AMERICAN. With the information there given one can form some idea of the present and prospective development of the system. From the little room figured, as many as six hundred lines (with an aggregate mileage of 650 miles) reach out to the offices and homes of as many subscribers in various parts of New York, Brooklyn, Jersey City, Newark, Orange, and connections are making or in immediate prospect with all other adjacent towns of any size. New lines are being added at the rate of five a day, and every new wire widens the range and increases the value of every other wire in the system. Very soon the Philadelphia exchange will be connected with that of New York, and then any subscriber in either city or its suburbs will be able to communicate directly with any subscriber in the other. Already from four to five thousand calls are made upon the exchange daily, during business hours, and the system has scarcely begun to occupy the vast field that lies open for occupation as rapidly as telephones and connecting wires can be set up.

The limits of our space forbid any attempt even to summarize the infinite range and variety of possible telephonic communication. Its scope is as wide, as limitless indeed, as is the range of communication possible between men. Any question that a business man may have occasion to ask of another, any instruction he may wish to give to a distant subordinate, any message that a boy can carry, and that may be written, falls within its province. Even at the low average of a mile for the distance between the widely separated subscribers in this city the five thousand daily communications mean five thousand miles of travel saved for somebody. And the time gained by the saving of those five thousand miles of travel means not less than a thousand hours of the most valuable portion of the day, an average of over an hour and a half daily to each subscriber. The increase of business efficiency due to such savings of time and trouble is beyond computation.

In its infancy, with the inertia of custom to overcome, the system has developed a capacity for growth that has distanced the expectation of the most sanguine, and its utility as well as its capacity for further development increases with every new wire, more especially with every new connecting link between central stations. Who, then, can have courage to predict even the immediate future of the system, or to attempt to forecast the social and commercial changes which the annihilation of time and trouble, and the doing away with the mediation of forgetful or erring servants, will bring in their train? Soon it will be the rule and not the exception for business houses, indeed for the dwellings of all well-to-do people as well, to be interlocked by means of the telephone exchange, not merely in our cities, but in all outlying regions. The result can be nothing less than a new organization of society—a state of things in which every individual, however secluded, will have at call every other individual in the community, to the saving of no end of social and business complications, of needless goings to and fro, of disappointments, delays, and a countless host of those great and little evils and annoyances which go so far under present conditions to make life laborious and unsatisfactory. The time is close at hand when the scattered members of civilized communities will be as closely united, so far as instant telephonic communication is concerned, as the various members of the body now are by the nervous system.

PROGRESS OF ARTIFICIAL ILLUMINATION.

The new year opens with unusual promise in regard to the future lighting of our homes and places of entertainment and business. Two novel and radically distinct systems of interior illumination are now before the public, both agreeing in offering strong assurances that relief from the inconvenience and imperfection of illumination by means of kerosene and gas is not very far away. Whether either or both will fulfill the promise of the day only time can tell. Both display a high degree of experimental success; but it is a different matter to meet successfully the more exacting requirements of every day use at the hands of all sorts of people.

One system is based on the division of light, however generated, the other on the division of the electric current and its conversion into light by incandescence. The first is the system experimentally developed by Messrs. Molera & Cebrian, of San Francisco, and illustrated in these pages some months ago. These gentlemen undertake to distribute radiant light, not the means of making light, such as gas or electricity. The system involves a central generator, whence light is transmitted in parallel beams through tubes to the places to be illuminated, and there thrown out by prismatic reflectors, and dispersed by proper lenses. In this way, the inventors claim to be able to disseminate the radiant energy of light with no greater loss of power than is experienced when the electric current is divided or when gas or oil is burned in separate lamps or jets. The system has been tried in San Francisco, and is said to work well. The inventors propose to light city streets and houses, as well as isolated dwellings, shops, churches, and the like, and are sanguine of success. To our mind, however, the system seems likely to exhibit its highest utility and economy in places where a single building is to be illuminated, and no facilities are offered for the economical employment of incandescent electric lights; this, of course, under the assumption that what is possible in laboratory experiments is practicable on a large scale and under the varying conditions of every day use. The sanitary and other advantages offered by this method of distributing light are such as to justify the strongest wishes for its practical success.

The other promising system of domestic illumination is that just brought forward by Mr. Edison, as described and illustrated on another page of this paper. To all appearances, Mr. Edison has got the lamp he has so long been searching for, and curiously it is not at all what he thought it would be a few weeks ago. In other words, the light is generated in a strip of carbonized paper and not in a spiral of platinum or other refractory metal. The light produced is perfect; the lamp is inexpensive and apparently durable; the economy of the general system in which it is used is tolerably clear; and all its details seem to have been worked out with Mr. Edison's usual cleverness and practical skill. The only question that remains undetermined at this writing is whether the lamp will stand the test of time. It seems almost incredible that a slender thread of carbon can withstand the intense heat of the lamp, even in a perfect vacuum, without volatilization or fracture; but the lamps are stated to have stood action of the current, both in ordinary and in extraordinary strength, long enough already to upset all reasonable opinion as to the behavior of carbon under such conditions, and there is now nothing to be done but to wait for time to determine what the ultimate issue will be. The fact that all its predecessors in the field of incandescence have sooner or later come to grief is the chief, if not the only one, compelling a suspension of judgment in the present case. We sincerely hope that no hidden flaw may discountenance the inventor's confident assurance of victory. The light is exactly what the world wants to see; and if it will only wear long enough to pay for itself, both the inventor and the public at large are to be heartily congratulated.

At this point it is proper to note the extreme simplicity of the new lamp and the lack of any startling novelty in its materials or construction. If the lamp justifies present expectation, it will have but one radical peculiarity, and that is success. And success, in a field beset with so many difficulties which men of science and practical experience have pronounced insurmountable, is the highest as well as the final proof of a great invention.

Less successful workers in the same field have been prompt to say: "Mr. Edison is mistaken: the thing cannot be done as he claims to do it." To which Mr. Edison replies: "The problem appears to be solved; time only can tell whether the solution is final."

The next objection is: "The lamp presents no new discovery; its elements are old, and everything in the system has been suggested or tried before."

To this Mr. Edison may as justly reply: "Grant that the lamp involves no discovery, that its elements are old; nevertheless, in combining old elements, I have produced a new product, an incandescent electric lamp which does what no other lamp has done; it will work and does work. Other men may have tried to do the same thing by the same means; they have failed; I have succeeded. Therefore, the lamp is fairly mine."

If Mr. Edison's success is verified by time and use, the world will frankly accord to him the credit which is his due. But whether he is successful or not, the field is still open. It is not possible that there can be but one solution to so complex a problem. Such an event never yet occurred in the history of invention. Whatever Mr. Edison's success may prove to be, it should serve as an incentive to other workers in the same field to take heart and go on to like achievements; and the greater his success the greater the assurance that others can do likewise, or possibly better.

ALEXANDER STUART.

In the death of Alexander Stuart, at his residence in Chambers street, Tuesday, Dec. 23, the city of New York lost one of its best known and respected citizens.

For more than forty years, Alexander Stuart, with his surviving brother, Robert L. Stuart, carried on the business of refining sugar on an extensive scale, under the widely and honorably known firm name of R. L. & A. Stuart. Their enormous refinery adjoined the residence of the deceased, and was within a block of the house in which the two brothers were born. Alexander Stuart had particular charge of the manufacturing part of the business, and gave his personal attention to the improvement of the machinery and to processes. He expended time and money freely, employing experts of the highest rank, such as Professor Torrey, a famous chemist in his day. By means of their skill and his own ingenuity the manufacture was carried to so high and pure a point that the firm's sugars commanded a better price in the market than those of any other manufacturer

During the last twenty years of its existence the firm employed from 250 to 300 men, and made from 35,000,000 to 40,000,000 pounds of sugar annually. In 1872, R. L. & A. Stuart retired from the refining business with ample means, and converted their enormous refinery into warehouses, the rentals of which afford a large income.

Since relinquishing the refining business the two brothers have spent their time and money in good works, contributing some years as much as a hundred thousand dollars to benevolent purposes. One of their last acts in this direction was the purchase of the magnificent Potter estate, at Princeton, New Jersey, and after refitting the mansion throughout, and making ample annual provision for its maintenance, they set the whole apart as a private residence for the President of Princeton College, Dr. McCosh.

Alexander Stuart was a man of marked character, genial in his manners, and of great benevolence of spirit, his gifts to religious and philanthropic objects being numerous and generous. By a long life of honorable enterprise and superior business capacity, he amassed a large fortune, and never failed to use it wisely.

EXCLUSIVENESS OF ENGLISH MANUFACTURERS.

One of the first things usually remarked by a foreign mechanic coming to this country is the readiness with which he obtains admission to any of our manufacturing establishments. To suppose he will be allowed, as is usual here, to freely walk about the premises and enter the different shops and departments of almost any large factory, simply as a visitor, without the intervention of some influential friend; without the necessity of feeing the "gateman," and not needing to assume any disguise, is so entirely different from his preconceived ideas, and the habits and notions in which he has been brought up, that he is generally greatly astonished. At first, too, especially if he be an Englishman, he is apt to think such liberty of inspection may be meant as an especial distinction, conferred upon him under the supposition that he is a person of more importance than he rates himself, until he becomes sufficiently well acquainted with the usages of the country to understand that such freedom is hardly counted any especial privilege.

The customs of European manufacturers generally, and of those in Great Britain particularly, are all against this way of doing business. To obtain admission to almost any of the large manufacturing establishments is generally a matter of a great deal of difficulty, to effect which it is often necessary to consult the head of the firm, present formal letters of introduction, and have passes come down from one to another through several different functionaries. It is difficult to see why this should be so marked a peculiarity in all kinds of business in England, except it be on the principle that many of the long established houses rather arrogate to themselves, from their age and financial strength, a position somewhat similar to that which the accident of birth gives to their aristocracy—thus making an "aristocracy of trade," as it were.

But true and lasting prosperity in any line of business is not developed or sustained on any such basis. From about 1840 until within the past five years, nearly every branch of industry in England had a most wonderful growth, and great fortunes were made among representative members of the middle classes. But this growth seems to have met with a severe check, and the close competition for the world's trade during the past five years has probably caused some reduction of the wealth accumulated in more prosperous times. Who shall say how much of this comparative decline in England's prestige as a manufacturing nation is due to this narrow spirit of exclusiveness, whereby inventions and improvements are necessarily limited, and the rewards therefor confined to the few? Here, every workman, from the lowest to the highest, is not only permitted to know how the work is done in every department of his business, but he is counted of little worth who does not at the same time make diligent efforts to understand all practicable ways of doing the work in his own trade and all branches related thereto. Our manufacturers, as a consequence, do not presume upon the ignorance and want of skill of their competitors, and suppose they will be able to hold in the future any advantages they may have to-day, except as they may constantly improve their productions and introduce more economical methods. They do not shut themselves up in an assumed superiority, not caring to know what others are doing, careful only to prevent their competitors from doing as well, for they know full well that, in the present progress of industry, what may be to-day's success may be comparative failure to-morrow. There is, therefore, a sharpness of competition here, and a rapidity of development which would be impossible within narrow lines and under a "dog-in-the manger policy;" and it is this spirit which has placed our manufacturers generally so far in advance of those of the rest of the world.

THE HEART AS A MACHINE.

The heart is probably the most efficient piece of physical apparatus known. From a purely mechanical point of view it is something like eight times as efficient as the best steam engine. It may be described, mechanically, as little more than a double force pump furnished with two reservoirs and two pipes of outflow; and the main problem of its action is hydro-dynamical. The left ventricle has a capacity of about three ounces; it beats 75 times a minute; and the work done in overcoming the resistance of the circulating system is equivalent to lifting its charge of blood a little short of ten feet (9·923 ft). The average weight of the heart is a little under ten ounces (9·39 oz.). The daily work of the left ventricle is, in round numbers, ninety foot-tons; adding the work of the right ventricle, the work of the entire organ is nearly one hundred and twenty-five foot-tons. The hourly work of the heart is accordingly equivalent to lifting itself twenty thousand feet an hour.

An active mountain climber can average 1,000 feet of ascent an hour, or one-twentieth the work of the heart. The prize Alp engine, "Bavaria," lifted its own weight 2,700 feet an hour, thus demonstrating only one-eighth the efficiency of the heart. Four elements have to be considered in estimating the heart's work: (1) the statical pressure of the blood column equal to the animal's height, which has to be sustained; (2) the force consumed in overcoming the inertia of the blood-veins; (3) the resistance offered by the capillary vessels; (4) the friction in the heart itself. This, in a state of health, is kept at its minimum by the lubricated serous membrane of the pericardium.

THE STRUGGLES OF A SUCCESSFUL INVENTOR.

The early struggles of Mr. E. B. Bigelow, whose recent death in Boston we have already noted, afford a lesson of pluck, energy, perseverance, and final success, which ought to be very encouraging to other young inventors, when things do not go as they would like. His whole life, too, furnished another and brilliant refutation of the untruth conveyed by the ancient saying, that a rolling stone gathers no moss; everything depends on how the stone rolls.

His father was poor, and he was early set to work on a neighbor's farm at small wages. His first invention, made when he was thirteen years old, was a hand loom for weaving suspender webbing. Next he invented a machine for spinning yarn. This brought him a little money; and at sixteen he attended an academy at his own expense. Here he became interested in stenography, wrote and published the "Self-Taught Stenographer," from which he hoped to make a fortune. But the venture landed him in debt. Then he undertook the manufacture of twine, and failed again. Later he made another failure in the manufacture of cotton, which increased his indebtedness to $1,400, a large sum in those days. Then he took lessons in penmanship, becoming so skillful that he was able to support himself by teaching the art. The work did not promise any great profit, and he thought he would like to be a physician. After taking a course of classical instruction he entered his name as a medical student.

At this point, while lying one night under a Marseilles bed quilt, he conceived the idea that he could make a power loom to weave such fabrics. He dropped his studies for invention, succeeded, and entered upon a new course of effort, disappointment, more effort, and final success. A Boston house promised him money to set up his looms, but failed before he could get started. His father was also unfortunate in business and in failing health. He thought he could make something by means of a power loom for weaving coach lace, and having found that there was a good market for such products, he set to work to invent the required loom. It was another success as an invention; and, better for him, it resulted in financial success. It gave him both money and reputation. But he was cut out for still better work, and he found it in the invention of power looms for carpet weaving, the history and effect of which have already been told in these columns. He set up the first successful power loom carpet factory in the world; and subsequently passed on from looms for weaving ingrain to the greater invention of power looms for Brussels carpeting. In all he took out thirty-six United States patents, and ultimately acquired great wealth. It is said, on good authority, that by his inventions, the cost of weaving coach lace was reduced at once from twenty-two cents a yard to three cents; and the cost of weaving Brussels carpet from thirty cents to four cents.

LOW WATER ON MANUFACTURING STREAMS.

The comparatively small amount of rainfall in the latter part of the summer and through the fall months, in most of the States along the Atlantic seaboard, was felt to be a serious inconvenience in most manufacturing towns where machinery is run by water power. In many large establishments much trouble was caused, because the water in the streams on which they had been accustomed to depend for their power was for weeks too low to allow of running full time, and in some cases a total cessation of work for a considerable period was necessary. We do not now refer to the hundreds of grist mills and saw mills throughout the country, which are run by streams and creeks that were never expected to operate them steadily throughout the year. Leaving these out of the account, it is probably not too much to say that the builders and owners of scores of large manufactories, who had thought their water power practically constant, have this year been so seriously inconvenienced that the question of their future supply of water becomes one of great gravity. For they see in the prolonged stoppages they were compelled to make the past season something more than the mere effect of an unusual drought, which may not occur once in a dozen years.

Much has been said and written by those who have studied the subject carefully, about the diminished rainfall in countries and sections where the forests have been cut down, and how the character of the streams in such localities has undergone radical change, they being more subject to sudden freshets, while for the greater portion of the year the volume of water they carry is largely reduced. But such considerations as these seem to have had little weight with our manufacturers. They know that our timber lands are being used up with the most wasteful prodigality, but they have hardly given the matter a thought, in the light of its probable effect upon their business. They have seen the tanners cut down vast regions of woodland, to obtain the bark with which to make leather, much as the stock men in Texas and on the River Plate, in South America, used to slaughter cattle for the hide and tallow, the one not caring what became of the timber, as the other was indifferent to the value of the beef, and this wholesale destruction of the original forests has seemed to be a matter in which they had no interest.

The past summer has been particularly suggestive of thoughtful reflection and more careful calculation for the future, in regard to this whole question, by manufacturers who would avoid investing large amounts of capital in buildings and machinery whose value may at no distant time be greatly impaired by the falling off in the water supply on which they depend for their power. The entire section of country of which the Adirondack Mountains form the center has been greatly changed in the past few years by the wholesale cutting down of trees which has been pushed on every side. It is natural, therefore, that the water courses which are fed from this region should begin to show the effects which everywhere follow such causes, and it is not at all surprising that the manufacturing establishments in the Valley of the Mohawk should this year have had greater reason than ever before to complain of a deficiency of water. The character of the Delaware River, and the streams which fall into it, has for many years been undergoing a similar change, and now like causes have commenced to operate throughout the Valley of the Susquehanna, in Pennsylvania and New York, where are some of the largest tanning and lumbering establishments in the country. It behooves all manufacturers, therefore, who are dependent upon water power to run their machinery, to look this question squarely in the face. It is not very likely that any stop can or will be put to the destruction of our forests, so long as we have any, while individuals or firms can make money in this way; but those who are tying up their capital in enterprises where the amount and permanence of the water supply is a prime consideration should take heed, while they have time, of the changes they have every reason to look for.

Mr. B. C. DAVIS, in renewing his order for continuance of his advertisement in the SCIENTIFIC AMERICAN, writes: "The four line advertisement of my business in your paper has already brought to me orders to the amount of fifteen hundred dollars."

The first river steamer to adopt the electric light is the Reuben R. Springer, which left Cincinnati on her first trip to New Orleans, Dec. 17, 1879.

THE JOHNSTON HARVESTER PRIZE.

Our readers are already aware that the field trials of agricultural machinery at the Paris Exhibition of 1878 resulted in an overwhelming victory for American manufacturers. The special prizes for exceptional merit, as displayed in these practical contests, were twelve objects of art—Sèvres vases—only eleven of which were awarded, no sufficiently meritorious competitor appearing for the twelfth. Of the eleven awards seven fell to Americans, one to a French exhibitor of an American machine, two to French exhibitors of French machines, and one to an English exhibitor.

In the harvesting tests thirty-five reapers were entered, but only one award was made to that class of machines—the splendid specimen of ceramic art shown in the accompanying engraving—and that fell to the Johnston Harvester Company, of Brockport, Monroe county, N. Y., who have just received their prize.

The vase, as will be seen from our engraving, is of the shape called "tazza." It stands ten inches high, the bowl having a depth of three inches and a breadth of fourteen and a half inches across the top. Outside the prevailing colors are blue and gold; within are panels of scroll work, tritons, and trefoils, with circular bands in gold. In the center is a raised medallion representing the city of Paris—a female head with a mural crown. Around the medallion are scrolls, rosettes, fruits, wheat ears, and other agricultural symbols. Around the body of the vase is a wreath of fruits, flowers, and grain, with a spiral pink band bearing the inscription, "Exposition Universelle, Paris, 1878," and medallions with agricultural symbols. The pillar is in blue and gold, with bands, frets, and festoons; and the foot has a circular band inclosing quatrefoils on a green ground, broken by four panels, severally containing the words "Sèvres," "Paris," "Exposition," "1878." The intrinsic value of the vase is placed at one thousand francs; but that is a small matter compared with its actual value as a testimonial to the practical superiority and exceptional merit of the reaper which earned it in a field contested by so many able rivals.

Jacobsen's Method for Photo Printing.

Prepare a carbon picture in the usual manner upon a sheet of glass, and surround the picture with a wooden frame which exactly fits round the sheet of glass. Then pour into the frame a mixture (not too hot) of one part of gelatine, one part of gum arabic, and two parts of glycerine. When the mass has stiffened in the frame, carefully remove the latter from the former with a knife, and with equal care invert the gelatine plate, with which the carbon picture will now be incorporated. To ink the picture use a ground glass roller, and the inking process proceeds most favorably when done upon a smooth, elastic support like that used for rolling letter press forms. The printing ink, which must be very thick, is previously dissolved in oil of turpentine or in benzole, and some of this solution, without the addition of varnish, is poured upon the plate and distributed over it by the glass roller.

The plate being inked, a sheet of uncoagulated albumenized paper corresponding in size to the picture is laid upon it, and an India-rubber roller is passed softly across the paper, which is then lifted off the plate. The albumenized paper, which absorbs moisture readily, should not be allowed to lie too long upon the plate for fear of the albumen dissolving off and dirtying the plate. It is not necessary to damp the plate with water, as it possesses sufficient moisture to allow of a dozen impressions being taken. Of course this moisture is exhausted at last, but the plate is sufficiently hygroscopic to absorb enough moisture from the atmosphere in the course of a few hours to allow of printing being resumed.

While in other lichtdruck processes the image is sunk into the plate and the ink has to sink into the shadows, this method has the advantage of furnishing a relief which facilitates printing. By this process, also, round objects, such as bottles and vases, can be printed—possibly even with colors, which could be burnt in."

The Entrance to New York Harbor.

A bill has been introduced in the House of Representatives at Washington to create a permanently deep, wide, and straight channel through Sandy Hook bar to the port of New York. The bill provides for the construction of such works on the seaward or outward side of Sandy Hook bar as may be necessary to effect permanently and beneficially the part known as the Swash channel "and the fourteen foot channel." The works are not to impede navigation, and they are to begin not later than one year from the passage of the act. The works are to be pushed so as to increase the depth six inches annually until the full depth of thirty-one feet six inches shall be obtained, otherwise the provisions of the act shall be void.

When the full depth is obtained the sum of $5,500,000 shall be paid. The sum of $30,000 is to be paid annually for the maintenance of the requisite depth, said payments to be made three months after the expiration of each year. The

SEVRES VASE—SPECIAL PRIZE, PARIS EXHIBITION.

terms and conditions of the various payments are as follows: $500,000 to be paid when a depth of 27 feet 6 inches and a mean width of 200 feet are obtained; $500,000 when a depth of 28 feet is obtained; $500,000 when a depth of 28 feet 6 inches and a width of 300 feet are obtained; $500,000 when a depth of 29 feet is obtained; $625,000 when a depth of 29 feet 6 inches is obtained and a width of 400 feet; $625,000 when a depth of 30 feet is obtained; $625,000 when a depth of 30 feet 6 inches and a width of 450 feet are obtained; $625,000 when a depth of 31 feet is obtained; the final payment in full of $1,000,000 when the full depth of 31 feet 6 inches and a width of 500 feet are obtained.

The persons engaged in the work are not to shut off the

SEVRES VASE—TOP VIEW.

flow of water through any of the channels over the bar by damming up, by the erection of jetties, or by impeding or controlling in any way the natural flow of the water, nor resort to dredging, blocking, or any stirring-up process, for the purpose of more quickly achieving the required depths, but shall make the channel permanently deep.

William A. Drown.

Mr. William A. Drown, one of the largest umbrella manufacturers in the world, died in Philadelphia, Saturday, December 13, in the seventieth year of his age. He was born in Portsmouth, N. H.

Weight Applied to Money.

At a recent meeting of the Bankers' Institute, London, Mr. Barclay V. Head, assistant keeper of coins at the British Museum, read a paper "On the origin and transmission of some of the principal systems of weight as applied to money from the earliest times to the age of Alexander the Great." Mr. Head stated that a theoretically perfect system in which all measures and weights were referable to one and the same unit had been attempted (if never quite attained) twice only in the whole history of mankind; once by the Babylonians in their sexagesimal system, and once again, after a period of 3,000 years, by the French in their decimal system. Numismatists were generally agreed that the Lydians, about 700 B. C., were the inventors of the art of coining, and that the earliest coins were composed of electrum—a natural compound of gold and silver found in the washings of the river Pactolus. This coinage lasted about a century and a half, and was then superseded by a bi-metallic currency of gold and silver, instituted by Crœsus. Henceforth bi-metallism in the currency became the rule in Asia down to the age of Alexander, being based upon the constant fixed ratio of 1 to 13⅓ between gold and silver. The currency of European Greece, Mr. Head believed to have been generally monometallic, based upon silver, not upon gold. This continued to the time of Philip of Macedon, in whose reign the rich gold mines of Philippi were discovered, and gold for the first time became abundant in Europe. Philip thereupon reorganized his currency, introducing bi-metallism, with the view of artificially keeping up the price of gold as compared with that of silver. This device was futile, and Alexander the Great returned to the ancient system of mono-metallism, based upon silver, though he coined gold. From this time the gold coinage was regarded merely as bullion, no attempt being made to regulate the value of one metal by the other. Mono-metallism henceforth became universal, even in Asia. This change from a double to a single standard in Asia was facilitated, in Mr. Head's opinion, by the sudden depreciation of gold (for the first time in history) consequent upon the dispersion by Alexander of the long-hoarded treasures of the Kings of Persia.

The "Kohinoor" Pearl.

Some months ago the pearl fisheries of the Miami River, Ohio, were described at considerable length in this paper. The past season has been signalized by the discovery of an agatized pearl, weighing forty-six and a half grains. The groundwork is beautifully agatized with the pearly iridescence shining through. It is the only pearl of the kind in pearl history, a history which dates back at least two thousand years, for the Ceylon fishery has been known for quite that length of time. Being the first of its kind, its value cannot be estimated. It is singular, too, that it was found embedded in the flesh of the mussel; all others taken from this river were found between the flesh and the shell, or embedded in the shell.

The prosecution of this industry is due largely to Mr. Israel Harris, a banker of Waynesville, Ohio, who has already a collection of over a thousand Miami pearls of all sizes and values, some of them of odd and irregular forms. Some resemble human hands; one is a small shell to which a coating of pearl has been added. His latest important acquisition, the agatized pearl, he calls the "Kohinoor."

A Large Consignment of Silkworms' Eggs.

A consignment of silkworms' eggs, filling six freight cars, and valued at $850,000, arrived in this city December 19, from Yokohama, by way of San Francisco. The eggs were from Japanese nurseries, and had been collected and consigned to silk growers in France and Italy by their agents at Yokohama. The route followed was chosen in preference to that by the Indian Ocean and the Suez Canal owing to the lower temperature. Great care has always been necessary by the Indian Ocean route, and, even when that was exercised, consignments were often spoiled by the high temperature in doubling the southern points of Hindostan. The increased number of transfers slightly injures the eggs, but the aggregate damage is considerably less by way of New York than by way of the Suez Canal. The eggs are packed in cases measuring three feet in length by about one foot in width and depth. Each case contains about 600,000 eggs, gummed to strips of cardboard separated by layers of tissue paper. From twenty to twenty-five strips are placed in each case, each strip containing from 30,000 to 35,000 eggs. With this simple packing and with due precautions against moisture and high temperature, these delicate structures are transported three-fourths of the

distance round the earth in perfect safety, provided always that a moderately cold fresh air is given free access to the quarters in which they are stored. Heat, it is stated, produces an immediate effect upon the development of the larvæ, thus rendering it impossible to deliver them in good condition for growing.

The partial failure of the European silk crop the past year has made an unusual demand for Japanese eggs, and other large consignments are anticipated.

EDISON'S LATEST ELECTRIC LIGHT.

It is somewhat strange that carbon, the only substance of any value for the contact surfaces of telephone transmitters, should also prove to be the only substance suited to the light-giving portion of electric lamps. The production of an electric light by the incandescence of platinum is, for the present at least, laid aside by Mr. Edison for the more promising and more satisfactory carbon. Not the carbon so familiarly known in connection with electric lighting, but a new article having different qualities, and remarkable both for the simplicity of the process by which it is made, and its efficiency as a light-giving body when raised to incandescence by the passage of an electrical current.

The discovery of this new form of carbon was partly accidental, but more the result of Mr. Edison's faculty of seizing upon the slightest suggestion and following it as long as it invites investigation.

The first carbon prepared by Mr. Edison for this purpose was formed of a thread enveloped in a paste made of lampblack and tar, and carbonized at a high temperature. This carbon thread, although not remarkably successful, gave sufficient encouragement to warrant further investigation in the same direction. After the trial of a number of other substances it was determined that the best of all was paper, simple plain paper, without lampblack or other applications. In making these carbons the quality of cardboard or paper known as Bristol-board is used.

The completed carbon is shown full size in Fig. 1; the blank from which it is made is shown full size in Fig. 2. It will be observed, by comparing Fig. 1 with Fig. 2, that the paper shrinks enormously during the process of carbonization.

The manufacture of these little carbon "horseshoes," as they are called at Mr. Edison's laboratory, is very simple. The paper blanks, after being cut by dies in the form shown in Fig. 2, are subjected to heat sufficiently strong to drive off by destructive distillation all volatile matters. The paper horseshoes thus prepared are placed with alternate layers of tissue paper in shallow iron boxes, and weighted down with thin plates of ordinary carbon. These boxes are closed by tight-fitting covers, and placed in a muffle, when they are raised to a high temperature, which is maintained for a considerable time. The only index of the completion of the process is the crackling of the oxide formed on the exterior of the iron boxes. After cooling the carbons are removed from the iron boxes and placed between the jaws of small platinum vises, *a a*, which are supported on thin platinum wires blown in the glass base and forming the electrodes. A portion of the glass base and the carbon and its supports are inclosed by a glass bulb, from which the air is so completely exhausted by means of a Sprengel pump that only a millionth part of the original volume remains.

Mr. Edison has improved the Sprengel pump so that high vacua may be produced in 25 minutes instead of the 45 hours consumed in the operation by some of our physicists. The vacuum is so nearly perfect that none of the tests to which the lamps have been subjected so far, indicate the presence of the slightest trace of air.

For making his Sprengel pumps and other vacuum apparatus, Mr. Edison fortunately secured the services of an expert glass worker, who was formerly engaged in the laboratory of the famous Geissler, of Bohn.

The electrical resistance of the slender carbon horseshoe is 100 ohms, and, while the lamp shown in Fig. 3 is intended to afford a light equivalent to a single four foot gas jet, it may be forced to give a light equal to that of 8 or 10 such jets. We saw a single lamp of this kind giving a light that enabled us to read the SCIENTIFIC AMERICAN 100 feet away. This was certainly an extraordinary performance for a piece of carbon having a surface no larger than that shown in Fig. 1.

One of the most remarkable experiments connected with the exhibition of these lamps was that of connecting one of them with the main electrodes by means of a yard of No. 36 copper wire, no larger than a horse hair. The light was maintained without heating this very small conductor. Of course a wire of this size is too small to use in regular practice, but it strikingly exhibits the advantage of having a light-giving body of high resistance.

The carbon is very tough and flexible, and not liable to be broken or injured by jars. We saw one of the carbon horseshoes nearly straightened before it broke. The carbon not only withstands rough mechanical usage; it is also proof against injury by the sudden turning on and off of the electric current. One of these carbons has been subjected to the severe test of applying and removing the electric current a number of times equivalent to 36 years of actual daily use, and yet the carbon is not in the least impaired.

The horseshoe form of the carbon has a great advantage over the straight pencil or the voltaic arc, the light being more diffused, and therefore softer and mellower, casting no sharp black shadows, nor giving such an intense light as to be painful to the eyes. The light resembles that of a gas jet excepting in the matter of steadiness, the electric light being perfectly uniform and steady.

The lamps are connected in multiple arc, *i. e.*, the two wires leading from the electrical generator run parallel to each other, and the lamps are placed between and connected with each wire. As Mr. Edison has his circuit arranged it does not make the slightest difference, so far as the lamps are concerned, whether one or fifty of them are in use; it does make a difference, however, in the power consumed at the generator. The regulation of the current is reduced to the simple matter of varying the intensity of the magnetic field in which the armature of the generator revolves.

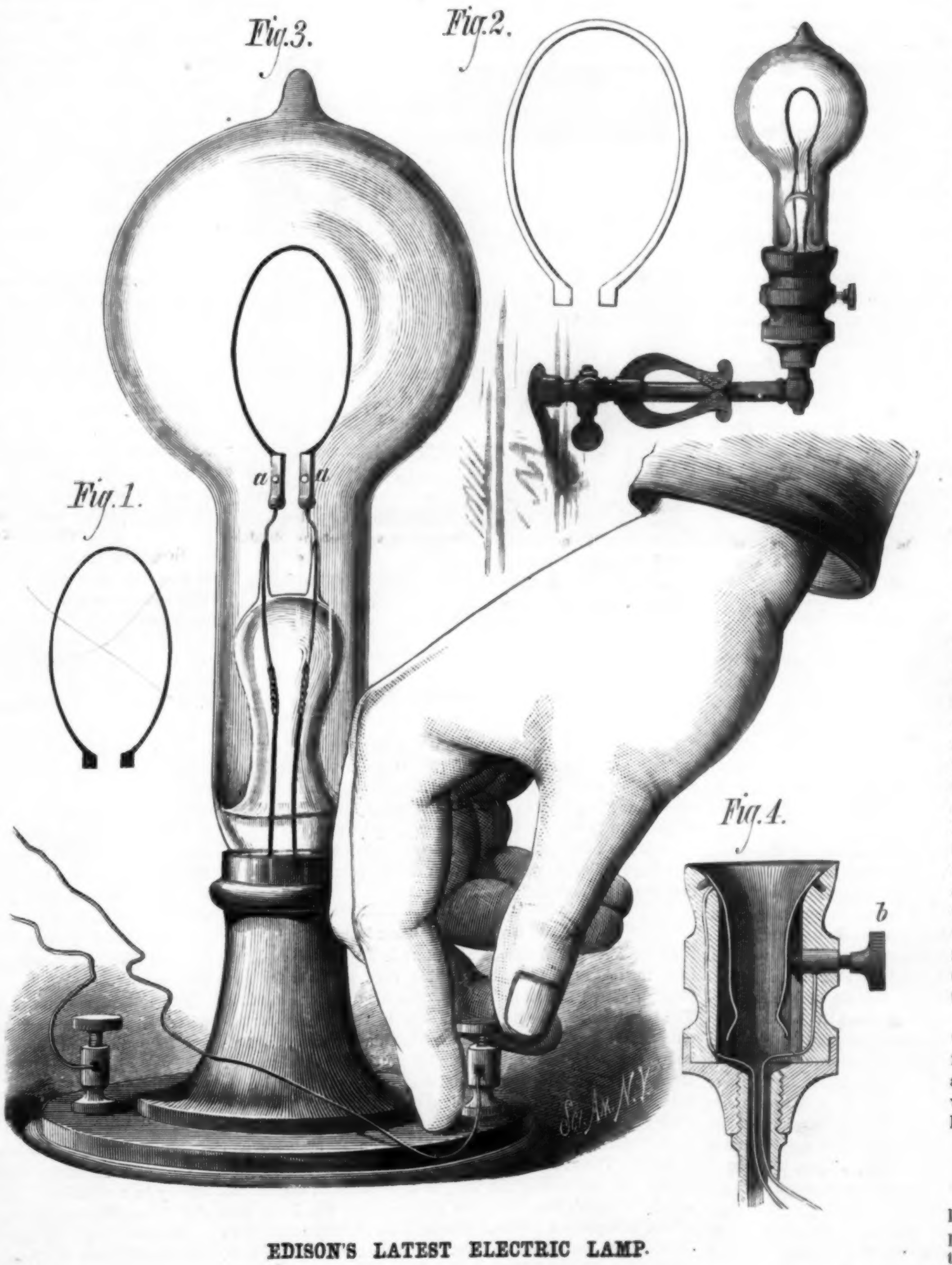
The entire lighting apparatus of a house, store, office, or factory, consists in the lamps and a few wires. There are no regulators, no complicated switches, no resistance coils to replace the lamps when the latter are not in use. The lamp, in its present form, is as simple as a candle, and, candle-like, it may be taken from its socket and replaced. This may be done while the current is on.

The construction of the socket which supports the lamp will be understood by reference to Fig. 4.

The lamp has attached to its electrodes slips of copper, which are bent upward against the sides of the glass, and touch two springs at opposite sides of the socket. One of these springs is connected with one of the electrical conductors; the other spring merely touches the copper strip, and does not form a part of the electrical conductor until it is touched by the thumb screw, *b*, this screw being connected with the second electrical conducting wire. To start the light it is only necessary to turn the screw, *b*, until it touches the spring. To stop the light the screw is turned in the reverse direction. From this it will be seen that the electric lamp is managed easier than a gas burner, as it requires neither lighting nor regulating.

On the evening of our visit to Mr. Edison's laboratory, he had more than thirty of these simple little lamps in operation, the current being supplied from one of his machines. Each lamp gives a clear, soft light equal to that of a four foot gas burner. These lamps had already been in continued operation for more than 48 hours, and they had seen altogether as much use as they would in 30 days of ordinary domestic or business service. The light certainly leaves nothing to be desired so far as its efficiency is concerned, and we are assured by Mr. Edison that, on the score of cheapness or economy, his system of illumination is far in advance of any other, not excepting gas at the cheapest rates. It seems that the subject of general electric lighting is now reduced to a mere question of time. If Mr. Edison's lamps withstand the test of time, he has unquestionably solved the vexed question and has produced what the world has long waited for; that is, an economical and practical system of electric lighting adapted to the wants of the masses.

The details given above were obtained by us direct from Mr. Edison and his assistants during a recent visit to the Menlo Park laboratory.



EDISON'S LATEST ELECTRIC LAMP.

Nitrolin.

A new explosive compound, known as nitrolin, is compounded as follows: From 5 to 20 parts of sugar or sirup are mixed with from 25 to 30 parts of nitric acid in a wooden or gutta percha vessel. Of this compound 25 to 30 parts are mixed with 13 to 35 parts of nitrate of potassa and from 13 to 15 parts of cellulose.—*Chem. Centralblatt.*

MISCELLANEOUS INVENTIONS.

Mr. David Booker, of Edom, Texas, has patented an improved implement for trimming and cutting and laying down hedges. It consists in a peculiar combination of knives and levers.

Mr. George C. Phillips, of Silver City, Nev., has invented a steam piston packing, which consists in making the suitable packing rings with their adjoining faces inclined in opposite directions, so that the pressure of the gland will compress and expand the packing rings alternately to pack the piston and stuffing box, such rings being used in connection with a conical sleeve of novel construction, which sits within the stuffing box and around the piston rod.

Mr. George H. Boszhardt, of Ida Grove, Iowa, has patented an improved attachment for the damper rods of stove pipes, furnace pipes, and other pipes and flues, which is so constructed as to hold the damper rod and damper in any position in which they may be placed, and at the same time indicate the position.

Mr. Benjamin B. Oppenheimer, of Trenton, Tenn., has patented an improved fire escape or safety device, by which it is stated a person may safely jump out of the window of a burning building from any height, and land without injury on the ground. It consists of a parachute attached to the upper part of the body, in combination with overshoes having elastic bottom pads of suitable thickness to take up the concussion with the ground.

An improved shirt has been patented by Mr. Richard O. Davies, of Newark, N. J. The object of the invention is to furnish shirts having fastening devices permanently connected with their neck bands and cuffs. It consists in the combination with the neck band and cuffs of shirts, of tabs having buttons fastened to their free ends, so that the buttons may be used for securing the neck bands and cuffs when required.

Mr. Truman S. Richards, of Woodman, Wis., has patented a buckle for use on harness, and for other purposes, to which the strap may be attached readily, without stitching, which will hold firmly, and permit ready disconnection of the strap. It consists in a buckle fitted with a wedge-acting slide or clamp fitted to move lengthwise of the buckle and clamping the strap, and the slide is also formed with serrations that act to hold the strap more securely.

Mr. Russell B. Griffin, of Osage Mission, Kan., has invented an improved butter package that perfectly protects the butter from weather, dust, etc. It consists in the arrangement of a butter package having its sides beveled or curved, and lined with cotton or linen cloth overlapping on top, and having two straps of metal, wood, or cardboard, to strengthen it.

Mr. Joseph McMullin, of Casey P. O., Iowa, has invented an improved implement for drawing dried fruits, sugar, and other materials from barrels. It consists in two bars formed with claw-shaped ends and pivoted together crosswise. The straight portions of the bars serve as handles, whereby the claw ends may be spread and then brought together, to pierce and separate the material. The points of the claws are of peculiar shape, by which they clear themselves when spread for dropping the fruit.

Mr. James C. Bowen, of Mandarin, Fla., has patented an improved refrigerator for shipping strawberries and other perishable fruits, which is so constructed that pieces of ice cannot be jarred out of the ice box to fall upon the fruit, and the waste pipe is arranged so that it cannot become clogged.

Mr. Louis Emile Jannin, of Paris, France, has patented an improved composition for stereotype moulds made from a cement composed of protoxide of lead and glycerine.

Mr. Levi Talcott, of Minetto, N. Y., has patented an improvement in fastenings for end gates of wagons. It consists of bolts provided with V shaped right-angular heads, held in a horizontal position, so as to be shot out from the ends of the gate and pass through mortises in the vehicle sides, where they are turned up at right angles to the mortise, thus fastening the sides and end gate together, and by the action of the heads the sides are drawn closely against the ends of the gate.

Messrs. George Wadsworth, of Boston, Mass., and Joseph P. Smith, of New York city, have patented an improved brush. This is an improvement in the class of bristle brushes used for painting, whitewashing, etc.; it consists in an arrangement whereby the bristles are firmly secured to the stock or head; also in providing the stock with a dovetailed core, along which the butts of the bristles are laid and secured by wooden strips on each side held under a metal ferrule securely fastened to the core outside of the bristles.

An improvement in violins has been patented by Mr. Carl Kreutzer, of New York city. This invention relates to the construction of violin bodies, the object being to improve the tone of the instruments and render them lighter, more ornamental, and less costly. The inventor constructs the back, belly, and sides from sheets of veneer or thin wood glued together with the grain crossing. These compound veneer sheets are cut out and stamped up to shape, and the body then formed by gluing the parts together. The ornamental edge is formed of a separate piece that consists of alternate layers of light colored wood and ebony, and is worked to a beaded form after attachment.

Mr. James T. Brown, of Saranac, Mich., has patented an improved fire-pot for soldering-iron heaters, which consists of a cylindrical metallic vessel or combustion chamber with a perforated bottom and side openings fixed centrally within a larger cylinder that is provided with a movable cover and smoke pipe; and it further consists of a circular shallow vessel, called a "generator," that is set in the top of the interior cylinder, and supplied with oil or gasoline, or other hydrocarbon, through a pipe connecting with an elevated reservoir.

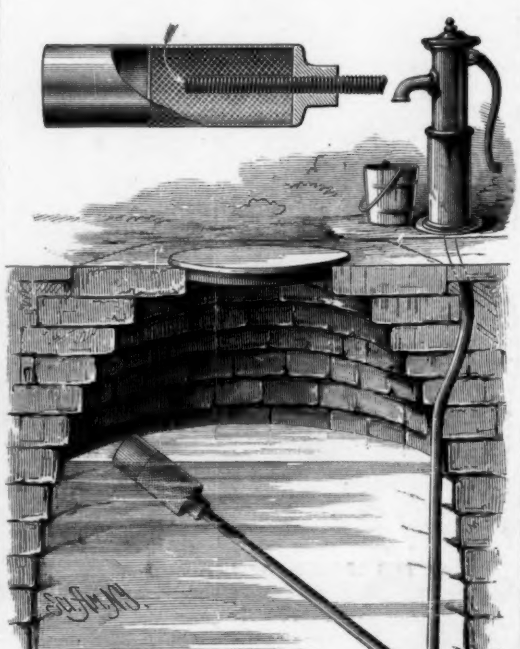
Horse Car Heaters.

New Haven horse cars are now successfully heated by a patent stove suspended under the middle of the car floor. The invention is a box 6 inches wide and high and 12 inches in depth or length, surrounded by a casing, into which air is introduced by perforations, other perforations leading to a reservoir of air under the seat, and the front of the reservoir opening into the car by register holes. The smoke escapes by a pipe passing through a similar reservoir or case, the pipe extending above the car roof at the driver's platform. The fuel is anthracite, giving off no visible smoke. Two cars so fitted, running 16 hours, burned but one bucket of coal.

A NEW FILTER.

The accompanying engraving represents an improved water-drawing and filtering apparatus recently patented by Mr. John B. Lindsay, of 117 West Third street, Davenport, Iowa. The detail view, which is partly in section, shows the internal construction of the filter. The large cylinder containing the filtering material has in one end an airtight chamber which buoys up the filter and keeps it at or near the surface of the water. Silicious sand, the filtering medium, is contained in the perforated portion of the cylinder, which is screwed on the end of the suction pipe of the pump. The portion of the pipe that projects into the cylinder is perforated and covered with wire gauze to prevent the entrance of sand to the suction pipe.

The pipe has a swivel joint which allows the filter to accommodate itself to the level of the water in the cistern or reservoir.



LINDSAY'S FLOATING FILTER.

The inventor of this filter claims that water taken from the surface is purer and better than that taken from the lower portion of the well or cistern; and he also states that there is a peculiar advantage in drawing the water through the filter rather than to allow it to pass through by its own gravity.

As soon as the pumping is stopped whatever impurities may have collected on the exterior of the filter drop off, so that the filter is really self-cleaning.

Tracing and Retouching Desk.

In the *Photographisches Archiv* Herr J. Terhelf gives directions for making a cheap retouching desk suitable for employing with artificial light during the long winter evenings. The requirements are a common, low petroleum lamp without a stand, having a round burner and a pyramidal pasteboard box. The latter is made by cutting four pieces of strong pasteboard into pyramidal shape, the bottom and sides each being about 12 inches in length and the top 3 inches. These four pieces of pasteboard are now fastened together so as to form a four sided pyramid, open at both top and bottom. The outside of the box is then covered with dark paper. In one side of the box, at a convenient height, cut a hole to permit the passage of the light; at the inner side of the hole place a piece of ground glass slightly tinted with Berlin blue, and on the outside, just at the bottom of the hole, paste on a strip of thick cardboard upon which to rest the negative. The desk being now ready place the lamp inside it and set to work. On account of its cheapness Herr Terhelf speaks only of making this retouching desk of pasteboard; but, if found convenient, one would think a less temporary one might be made in wood on the same plan, which could still be easily moved from place to place, or even, if provided with hinges, fold up into very small compass.

The Man who Forgot his Identity.

Our readers will remember the interesting case of forgotten identity reported not long since from St. Clairsville, Ohio. The publicity given by that report has been the means of discovering the antecedents of the unfortunate gentleman, who turns out to be Royal Cowles, formerly a jeweler of Cleveland, Ohio. A paper of that city says it is now definitely ascertained that when Mr. Cowles left Cleveland he was suffering under a terrible mental strain, which clouded his intellect. He had wandered aimlessly into the southeastern part of Ohio, when his condition attracted attention, and he was placed in a hospital at St. Clairsville. He has been fully identified by his friends; but whether the gap in his memory has been filled is not reported.

Correspondence.

The Utilization of Sawdust.

To the Editor of the Scientific American:

In your issue of December 13, I noticed an article under the title, "Invention wanted to utilize sawdust."

It is here a well known fact that sawdust, by itself alone, has been successfully used for producing potatoes. For this purpose it is only necessary to lay on the open ground, in rows of two to three feet apart, the potatoes that are to be planted, and cover the same with a bed of sawdust (say) from six to twelve inches thick. If the season is in the least favorable it will be astonishing how this method of culture will prove satisfactory. Another method, which I think preferable, is to prepare the soil by plowing and pulverizing, to open furrows two to three feet apart, to put in said furrows a four inch-layer of sawdust, on this lay the potatoes that are to be planted, covering them with another layer of sawdust, and over this a layer of the soil.

Sawdust can be used with advantage about fruit trees. Mixed with the soil it enriches the latter, and placed on its surface it maintains moisture and prevents the growth of many troublesome weeds. In vegetable gardens it does also very well, especially around cabbage plants.

Sawdust will rot as soon as any other vegetable matter, according to the species of wood from which it originates. Mixed with the soil it keeps the latter more mellow. An application of sawdust, say of three cart loads to the acre, during four years, over the poorest land and plowing, and cultivating same each year, will render it the most fertile.

Abbeville, La. A. D. MARTIN.

Traction Engines in the Sandwich Islands.

To the Editor of the Scientific American:

I am manager of the Kohala Sugar Company, Kohala, Sandwich Islands, and in your issue of February 15, 1879, you gave a sketch of our traction engine. I have taken the SCIENTIFIC AMERICAN for some years, and some time ago I noticed a leading article, in which you said in time the traction engine would be the feeders of all the main lines for farmers getting their produce to markets. I think you were right, and it may be interesting to you to know that the engine is a success with us. We have two more nearly due from England, and I expect during next year (1880) to do away with cattle altogether in hauling cane to mill, and intend, if everything goes right, to see in time what we can do at steam plowing. With our 10 H. P. engine we have been hauling to mill from 75 to 90 tons weight of cane per day from a distance of one mile on an average (two miles there and back), and taking the place of 80 head of cattle. We use on an average for this amount of work 800 lb. of common Sydney (Australia) coal per day. I got from New York 50 tons of Pennsylvania anthracite coal, but it would not do. It was too slow, and would not raise steam when we were going with a full load, which soft coal will do, and which you must be prepared to do on coming to a hill or up grade. In trying the engine, we brought 10 tons of cane (exclusive of weight of wagons) up a grade, rise 1 foot to 11 feet 3 inches, with 100 lb. steam, and in a pinch you can safely put on 150 lb. steam. I had a man from the shop in England come out to show us how to run her, and teach any one I wanted, and he will remain till the new engines arrive. We thought it best to go to this expense so as to be sure we should know what the engines could do, and we are satisfied that the expense of getting him out, and returning him, is not lost to us.

The new engines are of the latest patent, 8 H. P driving wheels 7 feet diameter, instead of 6 feet, and have a drum and 100 yards of wire rope attached, so that if the wagons are loaded in a boggy place, we block the wheels of the engine and run the rope out to the wagons and fetch them up to the engine by turning the drum. G. C. W.

What is a Cold?

On a less authority than the London *Lancet* would the theory be credited that the resolve of a person not to take cold is ample protection against having one. "It is startling to discover," says the *Lancet*, "how little we know about the commoner forms of disease. For example, a 'cold:' what is is it? How is it produced, and in what does it consist? It is easy to say a cold is a chill. A chill of what part of the organism? We know by daily experience that the body as a whole or any of its parts may be reduced to a considerably lower temperature than will suffice to give a man a cold if the so-called chill be inflicted upon the surface suddenly. Is it, then, the suddenness of a reduction of temperature that causes the cold? It would be strange if it were so, because few of the most susceptible of mortals would take cold from simply handling a piece of cold metal or accidental contact with ice. The truth would seem to be that what we call cold taking is the result of a sufficient impression of cold to reduce the vital energy of nerve centers presiding over the functions in special organs. If this be the fact, it is easy to see why nature has provided the stimulus of a strong fit of sneezing to rouse the dormant centers and enable them at once to resume work and avoid evil consequences. This explains why the worst effects of cold do not, as a rule, follow upon a 'chill' which excites much

sneezing. Shivering is a less effective convulsion to restore the paralyzed nervous energy, but in a lower degree it may answer the same purpose. The shivering that results from the effect of a poison on the nervous centers is a totally different matter. We speak only of the quick muscular agitation and teeth chattering which occur whenever the body is exposed to cold and evil results do not ensue. It follows from what we have said that the natural indication to ward off the effects of a chill is to restore the vital energy of the nerve centers, and there is no more potent influence by which to attain this object than a strong and sustained effort of the will. The man who resolves not to take cold seldom does."

THE TELEPHONE CENTRAL OFFICE SYSTEM.

[*Continued from first page.*]

is represented in the larger view in the engraving. Each person having the use of a telephone connected with the central office is called a subscriber, and his wire entering the office is connected with a small switch—a jack-knife switch; just below his name, and by this switch an electrical communication between the line and one of the annunciators above the switch is established or broken.

The arrangement of a telephone line in its normal condition is as follows: One wire from the subscriber's local battery is grounded; the other connects with the push button seen at the side of the desk. When this button is pressed the current from the local battery passes through the line wire, through the switch at the central office, through the magnet of the annunciator to the ground. The effect of the passage of the current through the annunciator is to release the little cover concealing the number of the subscriber's wire, permitting it to drop and expose the number. On seeing the number, the switchman connects his portable telephone with the subscriber's line, by inserting the plug at the end of the flexible telephone cord in the jack-knife switch. This operation not only connects the switchman with the line, but it also breaks the connection between the subscriber's line and the annunciator. The switchman's telephone being already connected with a battery and induction coil, and in condition to talk over the subscriber's line, he says to the subscriber, whom we will call A: "Well, A; what will you have?" A then says: "Connect me with B (say) at 25 Wall street."

The switchman then connects A's jack-knife switch with one of the long horizontal bars seen below; switches and turns the bar slightly, to indicate that it is occupied. He then goes to B's jack-knife switch; inserts one end of a flexible cord in the switch, and taps on a long brass strip connected with the central office battery, thus sending electrical impulses through B's line wire, ringing B's bell, when B removes his receiving telephone from its switch, and listens while the switchman connects B's jack-knife switch with the same horizontal rod that is connected with A. He then removes A's connection from the rod, and tells A "All right; go ahead," when the conversation between A and B proceeds. It takes only seconds to do what has required minutes to describe.

The boys attending the switches become expert and rarely make mistakes, although it is difficult to see how anything could be done correctly amid the din and clamor of twenty or thirty strong voices crying, "Hello! hel-l-o, A!" "Hello, B!" "What will you have?" "Who?" "Which?" "What?" "A-l-l right," and so on. It seems anything but orderly and systematic; but, nevertheless, it is the very embodiment of order and system. There are no less than six thousand calls per day; yet there is no delay, no mistakes, no trouble, save from the occasional breaking of a wire or the crossing and interference of one wire with another.

An idea of the activity of a telephone central office may be obtained from the larger view. The actual condition of things is far from being exaggerated.

It doubtless will be asked, How is it known at the central office when A and B have finished talking? The clearing out relays shown in one of the lower views, and at the farther end of the office in the upper view, indicate this. These relays, which are of comparatively high resistance, are each arranged to work a local circuit in which there is an annunciator representing one of the switch rods.

Each horizontal switch rod is connected with one of the relays, and all of the relays are grounded. Now A, having begun the conversation through the telephone, must indicate when it is ended; therefore, upon hanging up his receiving telephone, he pushes the button four or five times, working the relay, and consequently the annunciator connected with it, indicating that whatever is connected with the horizontal switch rod whose number corresponds with that of the annunciator, may be removed, and the switch rod may be used for C and D, or any one else.

One desk, seen at the right of the larger engraving, is the chief operator's desk, and the line-men, whose business it is to rectify troubles, get their orders at this desk.

There are upwards of 600 wires entering this office alone, and it requires over a thousand cells of battery to work this maze of wires.

Persons desiring to avail themselves of this means of communication subscribe to certain conditions, which require, among other things, the payment of a monthly rental, and the observance of the rules of the company. Men are then sent from the central office to place the telephone and battery, and to run from the subscriber's telephone to the central office a wire, supporting it at intervals by poles and fixtures as in the case of telegraph lines. The line and the instrument are kept in order by the company. Any imperfection in the action of either reported to the chief operator's desk at the central office receives immediate attention, men being sent out at once to find and remedy the trouble.

An alphabetically arranged list of subscribers is furnished with each telephone, and as new subscriptions are made, supplementary lists are furnished to all subscribers.

Among the recent improvements in telephone exchanges is the portable switchman's telephone, which is clearly shown in the lower left-hand view in the engraving, and the switch rods, shown in the same view, and also in the larger one. The latter are the invention of Mr. T. G. Ellsworth, the manager of the central office. They certainly save a great amount of labor, and prevent confusion and trouble.

The telephone, like many other modern inventions, needs to be used to be appreciated. It is wonderful enough that we are enabled to talk to persons in all parts of this great city, but when we can talk without difficulty with persons in neighboring cities, it becomes even more wonderful and interesting. The lines which connect New York with Newark run under the North River. Those that connect New York and Brooklyn are suspended from the East River bridge towers. The wires may run under ground, under water, or high in air.

The large and rapidly-increasing number of telephone lines indicate the growing popularity of this means of communication, and we confidently expect at no distant day to see it almost universally adopted for business and even domestic purposes. Already the wires extend in every possible direction from the central office, and fairly darken the sky in some localities. The Gold and Stock Telegraph Company have in this city three exchanges similar to the one we have described, connected with each other, and, with the central office systems, several of the adjoining cities. Jersey City, Newark, and Orange, N. J., and Brooklyn, N. Y., are so connected. Yonkers, and, in fact, all of the other important cities surrounding New York, will undoubtedly be telephonically connected with the metropolis before the beginning of another year. We understand New York and Philadelphia are soon to be connected in this way. The convenience of such means of communication is thoroughly appreciated by business men, whose operations are confined to a few hours, and whose time is valuable. The SCIENTIFIC AMERICAN has constant proof of the utility of this invention, as there is scarcely an hour in the day that the telephone in the office is not used in communicating with some one, either in this or one of the adjacent cities.

ON THE DEPHOSPHORIZATION OF IRON.

BY PROF. MAURICE KEIL.

Science has of late years made fast strides, and one scientific fact after the other has been forced to yield the point which it is the business of our utilitarian age to force from facts. In the chemical metallurgy lately the perfection of the process for the dephosphorization of iron has caused quite a sensation, and has set scientists to work for further investigation. Not long ago the convenient and economical use of our most reliable metal—iron—was hampered by the facility with which it rusted and decayed. Once attacked by rust, the rust point was a center from which proceeded further corrosion with fatal rapidity; but also in this instance, true to the exacting spirit of the age, nature has been made to yield up her secret, and iron is to wear in future a protecting coat of oxide of iron, to the perfection of which centuries testify.

In the new dephosphorization processes of Krupp and Bell, and of Thomas and Gilchrist, a problem has been solved which has baffled the scientific world for years. And it must be admitted as a great invention, the importance of which it is scarcely possible to exaggerate. In the light of the past history of inventions, it is not surprising to find that the development of this important process is not the work and thought of one man. The same end certainly has been accomplished, independently, but by different means. The importance of the invention lies in the fact that, while up to the present districts which had only at their disposal iron ore of a phosphoric nature exclusively, were not able to produce any forged iron or steel, will now be able by means of this process to work iron up to any imaginable form or shape or manufacture steel. This process will certainly also revolutionize a complete alteration in the relative iron production for the future.

As remarked above, both processes are alike in principle but different in execution. The process of Krupp and Bell is divided into two stages. First, elimination of the phosphor (100 parts of iron melted in a cupola oven to 15 of oxide of iron, or 25 per cent consumption of ore if worked in a Siemens-Martin furnace) in a rotating oven attained a reduction of the phosphor from 0·6 to 1·2 up to 0·13 to 0·3, therefore a refining, and afterward conversion of the refined iron in the converter. Silicium iron must be added to the product, as this is taken away in the first stage.

In the Thomas and Gilchrist process both stages are united in the converter, as by means of a basic lining and basic flux the elimination of the phosphor is produced, as shown further on.

Taking particularly this process the last experiments that have lately taken place in an eight ton converter fully demonstrate the complete success of the invention, which is as follows:

The converter used for the experiment was lined with basic bricks, of the following chemical composition: $SiO_2 = 9{\cdot}50$, $CaO = 50{\cdot}21$, $MgO = 21{\cdot}50$, $Al_2O_3 = 10{\cdot}00$, $Fe_2O_3 = 4{\cdot}46$ $NaO = 4{\cdot}00$, and it had a perforated bottom of dolomite, for want of the exchangeable pipes, which could not be obtained, as they had not been manufactured.

The gray Cleveland pig iron, which had been remelted in a cupola oven, contained: $Si = 3{\cdot}030$, $C = 3{\cdot}200$, $P = 1{\cdot}800$, $S = 0{\cdot}030$, $Mn = 0{\cdot}450$, of which 5 tons 18 cwt. were poured into the converter.

Directly afterward there were poured in (about 20 per cent against the above in-put) 21 to 24 cwt. of flux of a mixture of limestone and oxide of iron (20 to 27 per cent of blue billy), which before had been melted together into firm pieces of the following chemical composition: $SiO_2 = 1{\cdot}000$, $CaO = 60{\cdot}000$, $Fe_2O_3 = 31{\cdot}890$, $CO_2 = 6{\cdot}400$. After which the converter was raised upright and blown with 120 cm. column of quicksilver.

By the first charge, after four minutes the line of natron appeared in the spectrum, while during the period of boiling a large quantity of iron was thrown out; after 17 minutes the green lines had disappeared, and by usual hematite melting the process would have been finished with this charge. But the blowing was continued for another 1⅛ minutes, the converter tilted, and a proof taken in the usual manner, which still showed a luminous grain proceeding from considerable alloy of phosphor. The process was therefore continued for another minute and 22 seconds, after which no trace of phosphor was perceptible. Now followed the addition of spiegel iron in a liquid state, containing 22 per cent of manganese, in proportion of 9½ per cent to the pig iron put in, which created a violent reaction, and the slag was thrown out in powerful columns of flame. On the pouring out in the casting pans the steel appeared agitated and of soft quality, but rose in the pans and was uncovered in the usual manner. The converter, after running quite empty, did not show the least trace of injury, the borders of the bottom perforators were strongly marked, the joints of the bricks were regular, somewhat darker as the glowing brick matured, but perfectly uninjured. The finished steel showed the following composition: $C = 0{\cdot}171$, $Mn = 0{\cdot}160$, $P = 0{\cdot}223$, $S = 0{\cdot}037$, $Si =$ traces.

The blocks were afterward transferred to the gas furnace and rolled in quadruple lengths for rails. The experiments were highly satisfactory, and a special advance to the Bessemer process.

MECHANICAL INVENTION.

An improvement in windmills, patented by Mr. Thomas Dewees, of San Antonio, Texas, consists in arranging three stationary sails between arms on central shaft, so as to obtain double or increased power from the air passing through the wheel.

MIASM AND FEVERS.

Abundant experience has already established the following facts regarding the appearance of intermittent fevers and the causes which are designated as *malaria:* First, that the real cause is to be sought for in the soil, where it is developed in greater intensity under favorable conditions of heat and warmth; second, that this poisonous substance, when the surface is dry, is lifted up a little above the surface by ascending currents, and can then be carried further or raised to a greater height by stronger draughts of air; third, that this substance, the cause of the malaria, is not developed in every soil of the same composition and the same degree of moisture, a circumstance which has repeatedly led to the assumption that it possesses the nature of a specific organism, which requires for its development not only the most favorable conditions, but first of all a *germ* from which it is developed.

From time immemorial the Roman campagna has been known as one of the poisoned plague spots of the earth, hence the interest that naturally attaches to the investigations made there last spring by Klebs and Tommasi-Crudeli.

The malarial powers of different kinds of soil, of water, and of air, were tested. The solid and liquid portions of the former were tested separately. Under the supposition that the germs of the disease were organism, substances rich in infective matter were exposed to those conditions which have been found by experience most favorable to the development of the disease (30° to 40° C., or 86° to 104° F.; plenty of moisture deeper in the soil and rapid evaporation on the surface). Small particles of substances thus prepared were transferred to different liquids for cultivation, and then experiments were made to determine whether, after frequent successive fractional cultivation, the same activity was present as in the substance first employed. Finally, the liquid was mechanically separated from the solid microscopic particles in the cultivated liquids, as in the original, by filtration through gypsum and other filters, and the relative activity of filtrate and residue separately examined. To test the activity of these different substances they were injected hypodermically into rabbits; the temperature was measured every two hours, and the dead body examined. The regular intermission of the fever and the swelling of the spleen and want of other changes were employed as guides and measurements.

The results may be briefly summarized as follows.

1. The malarial poison is found in large quantities and largely disseminated through the soil of malarial districts at a season when people are not yet attacked by disease.

2. At these times it may also be obtained, in especially

favorable places, from the strata of air nearest the surface. To test this, 300 liters of air were thrown with great force and velocity against a glass plate covered with glue solution, to which the solid particles in the air adhered.

3. Stagnant water in malarial districts seemed not to contain the disease, although it may be, like the lake of Caprolace, extraordinarily rich in lower organisms. Their experiments indicate that a large quantity of water hinders the development of malarial poison and renders the germs which are present inactive.

4. By infection with the above fluids, some directly from the soil and others prepared by cultivation and filtration, a fever was produced in the animal of the regular type, with intermissions, which lasted up to 60 hours, and an increase of temperature up to 40° C. (104° Fah).

5. The filtered liquids caused but very slight increase of temperature even when five times the quantity was injected. Even filtering through a double paper filter seems to remove the malarial poison.

6. Animals infected with malarial liquids all showed a swelling of the spleen, and in many of them was found a black pigment.

7. The organisms which were the real cause of the malaria belong to the genus *Bacillus*. They are present in the soil of malarial regions in the form of numerous movable brilliant spores of long oval shape, with a greater diameter of 0·95 micrometer. They grow, both in animals and in cultivating apparatus, into long threads, which are at first homogeneous, but afterward divide and develop again within the limbs. These spores first form on the walls, but finally the whole interior of the member becomes filled with these little bodies. Owing to their peculiar morphological action they must be looked on as a new kind of bacilli, and have been named *Bacillus malariæ*.

8. These organisms will not develop if atmospheric oxygen is excluded, and hence belong to the class of Aerobii. They do not develop in water, but will in nitrogenous liquids, like solutions of glue, albumen, and the fluids of the body. Sometimes the fibers reach the length of 0·06 to 0·084 mm.

ANOTHER EXTINCT RACE THAT NEVER EXISTED.

One of Mark Twain's best points was made when he described the Indians of Cooper's novels as an extinct race that never existed. Now Professor Stephenson, of the Hayden surveying party in New Mexico, is charged by a Chicago paper with giving a similar report of the Aztecs. He says they are a myth, and that the tribes known as the Cliff-dwellers are to be credited with all the romance attached to the Aztec name. New Mexico is full of their buried towns and cities. During his summer's work in New Mexico, Professor Stephenson made a number of valuable collections, including skeletons and remains of extinct animals. Among his trophies are two gods of Egyptian character, with finely cut features, outstretched wings, and traces of paint on their faces. The Professor brought away specimens of pottery bearing a close resemblance to that unearthed in the ruins of the Old World, and also secured the secret of its manufacture from the Indians, who still make it in New Mexico.

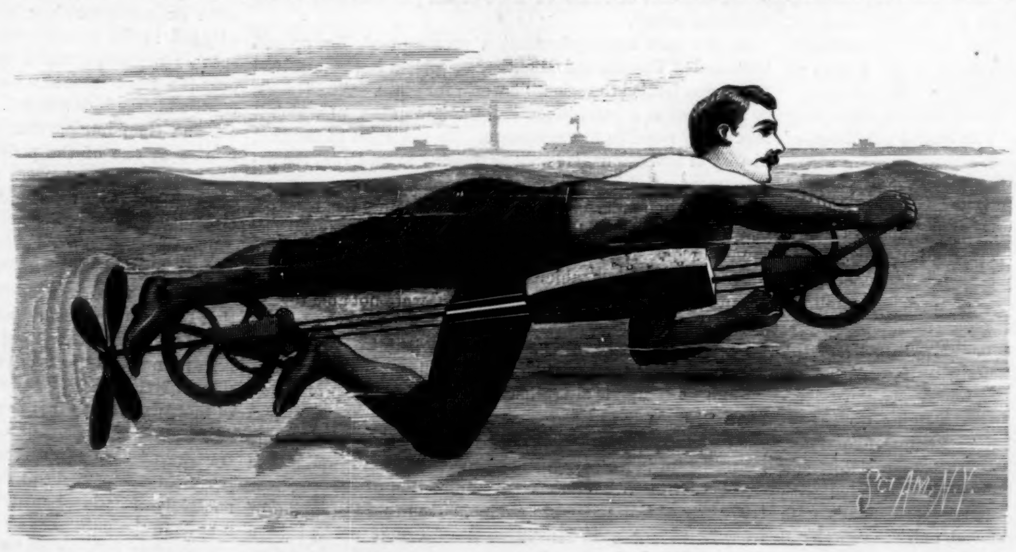
NOVEL SWIMMING DEVICE.

We illustrate herewith one of the most novel applications of machinery that has come under our notice. It is a singular craft without hull or engine, but nevertheless apparently correct in principle and capable of practical application. This swimming apparatus, recently patented by Mr. William H. Richardson, of Mobile, Ala., consists essentially of a light frame carrying a float and a longitudinal shaft, having at one end a small screw propeller and provided with gearing for running the propeller.

The swimmer reclines on the float, and, grasping one of the hand cranks in each hand and placing his feet on the two foot cranks, proceeds rapidly and easily, with the head far enough above the surface of the water to be comfortable without extra exertion.

The inventor asserts that a swimmer with one of these machines can, under favorable circumstances, make from four to five miles an hour without undue exertion.

Further information in regard to this novel device may be obtained from the inventor.



RICHARDSON'S SWIMMING APPARATUS.

Substitute for Cod Liver Oil.

According to the New York *Medical Journal*, Dr Thomas A. Emmet, of this city, in his recent work on the "Principles and Practice of Gynecology," recommends the fat of pork, properly prepared, as an excellent substitute for cod liver oil. A portion of a rib, free from lean, is selected and soaked in water thirty-six hours to get rid of the salt. It is then boiled slowly, the water being often changed, until the meat is thoroughly cooked. It is to be eaten cold in the form of sandwiches, cut very thin. Thus prepared, it forms, according to the author, a very nutritious and concentrated article of diet, and one which can often be retained by irritable stomachs.

JUVET'S TIME GLOBE.

For many years it has been the ambition of horologists to apply by some mechanical device a motor to a terrestrial

JUVET'S TIME GLOBE.

globe, that, while it should show the exact diurnal revolution, should also be so constructed as to have utility as a timepiece. Various and ingenious methods have been devised, putting a clock in a case and projecting above its base a rod with a gear coupled into another on the equatorial portion of the globe. A French inventor made a globe in the shape of a dome, exhibiting only the northern part of the earth, and by an impelling mechanism turned it on its axis. These and other crude and cumbersome mechanical devices prevent any other than a rigid position, and one that could not accurately illustrate the earth's polar position. A sphere that shows but a half globe, or one that necessitates a fixed horizontal or perpendicular polar projection, is calculated to mislead and not instruct. The requirements for a perfect scientific instrument of this kind are excellence as a time-keeper, accuracy, clearness, and completeness of map surface. It must admit of being easily examined, and should be capable of any inclination necessary for terrestrial or other planetary illustrations.

Any exterior mechanism precludes these essential requirements.

Mr. Louis Paul Juvet, a native of Neufchatel, Switzerland, but for some time a citizen of the United States, after years of patient effort has devised a time globe which avoids the imperfections of its predecessors. This globe, which is shown in the accompanying illustration, has a chronometer movement in its interior. The shell that envelops the works and protects them against accident or dust is very light and uniform in thickness, allowing the mechanism to turn freely, equably, and in perfect balance. The globe surface is as hard and smooth as a sheet of steel, being made of an entirely new material, which is unaffected by moisture, or heat, or cold. The meridian ring used for the support of the globe at its polar extremities, graduated for the measurement of latitude, is placed at some distance from the sphere to give lightness and beauty, and also to admit more easily examining the globe surface. It is held in any desired position by a simple swiveled clutch and holder. At the northern end the meridian ring is expanded into a holder for a transparent heavy plate glass clock dial, with the usual hour figures and minute marks. The hands are under the dial and the time is easily read, yet the dial is not an obstacle to the free examination of any portion of the globe. At the equator a zone dial encircles the globe, the hour figures and minute marks on which, by following the meridian line of any locality to it, gives the exact time of any place. In the illustration the hands of the clock show 12:20, the local time of New York city, the meridian line of which, it will be seen, stands also before 12:20 P.M. on the equatorial dial. It will be noted, also, that San Francisco is yet on the morning side of the meridian, while London is almost in darkness, and stands before 5:16 evening on the equatorial zone.

One half of the equatorial zone is darkened, being nearly black at midnight and shaded lighter on the left to 6 A.M., and on the right to 6 P.M., thus showing at a glance which part of the world is in daylight and which in darkness. The automatic motion of the globe, reproducing on a small scale the very movement of the earth, illustrates the phenomenon of day and night, and solves a problem that, simple as it is, is yet incomprehensible to many.

This globe is, in fact, a miniature earth in position and motion, being lightly and yet strongly made, with every portion of it visible. A clock and globe gives local and universal time with accuracy. It measures by its motion the comparative, and by the simplest computation the exact size of any country as it passes the meridian ring and equatorial zone. It can be placed in any position without derangement, and we are informed that it cannot be fractured by blows. It is unaffected by climatic changes. It is covered by a map which is a special edition of the celebrated Edinburgh (Johnston's) maps corrected to date, having all the recent political changes and geographical discoveries, and also blue lines indicating average winter, and red the average summer temperature of every country on the globe; the water being represented in blue of a desirable shade clearly shows by the white lines the ocean currents. Whenever a change in the boundaries of countries, addition of States, or important discoveries make it desirable, this globe can be remapped at a nominal expense. The axis of the earth is represented by a gracefully shaped arrow, the feathered end of which is used as a stem winder for the clock within, which runs four days, and is regulated from the outside. The works are simple, and can be taken apart or repaired by any mechanician.

It received the highest award of the Centennial Exhibition at Philadelphia, and has the most cordial indorsement of scientists at home and abroad. It is mounted simple or ornate, to meet various tastes. It is a fit ornament for any library, a valuable adjunct in every business office, and a necessity in every institution of learning. This beautiful piece of apparatus is patented in this country and in Europe.

For further information address Messrs. Juvet & Co., Canajoharie, N. Y.*

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FISH CULTURE IN CANADA.—A Canadian official report states that during the fiscal year 1877–78 a sum of $20,088 was expended in restocking waters with fish, the number of young fish distributed during the year exceeding 27,000,000.

*See advertisement on another page.

AGRICULTURAL INVENTIONS.

Mr. Henry Bell, of McGregor, Iowa, has invented an improved centrifugal churn, which he claims is simpler in construction and of superior efficiency to others now in use.

An improvement in cotton picking machines has been patented by Mr. Frederick F. Trenks, of Round Top, Tex. This improvement relates to machines for picking cotton from the plants by means of a picking cylinder provided with curved fingers and flanges extending beyond the picker fingers.

An improvement in cultivators has been patented by Mr. Peter Gerges, of Skippack, Pa. The object of this invention is to furnish an improved cultivator which shall be simple, convenient, and effective. It consists in a single beam combined with standards and auxiliary blocks and bolts.

Mr. Marion Smail, of Crawfordsville, Ind., has patented an improvement in combined grader and stalk cutter which consists in combining a drum and loose semi-cylinder with mechanism for operating them.

THE BASKET FISH.

BY H. C. HOVEY.

This elegant ophiuran (or serpent star) has a measure of historic as well as scientific interest. Hon. John Winthrop, who deserves to be called the pioneer of American naturalists, laid aside for a while his cares as Governor of Connecticut, saying, "We shall omit other particulars here, that we may reflect a little upon this elaborate piece of nature." His account of "A Very Curiously Contrived Fish" was published, in 1670, in the "Philosophical Transactions of the Royal Society" (vol. iv. and vol. vi.); and though not up to the present standard of exactness, it is quite accurate as well as graphic, and is remarkable as being the first purely scientific paper from New England. With excusable hesitation, and giving his reasons for doing so, he called the new and nameless fish "*Pisces-echino - stellaris - visciformis,*" which has since yielded to the shorter title of *Astrophyton*. He considerately suggested also the English name of basket fish, on account of its resemblance to wicker work; and this is still the name by which it is known among the fishermen from Nantucket to Labrador.

For full details as to the geographical distribution, anatomical structure, and special marks of the entire family of *Astrophytidæ*, the reader is referred to Lyman's "Catalogue of the Museum of Comparative Zoology," at Harvard College, and other scientific works. The species peculiar to our coast is named for the celebrated Agassiz, and described by his son in "Seaside Studies." It is perhaps the least useful and most ornamental creature caught in the Northern Atlantic; and specimens, dried or in alcohol, adorn many cabinets.

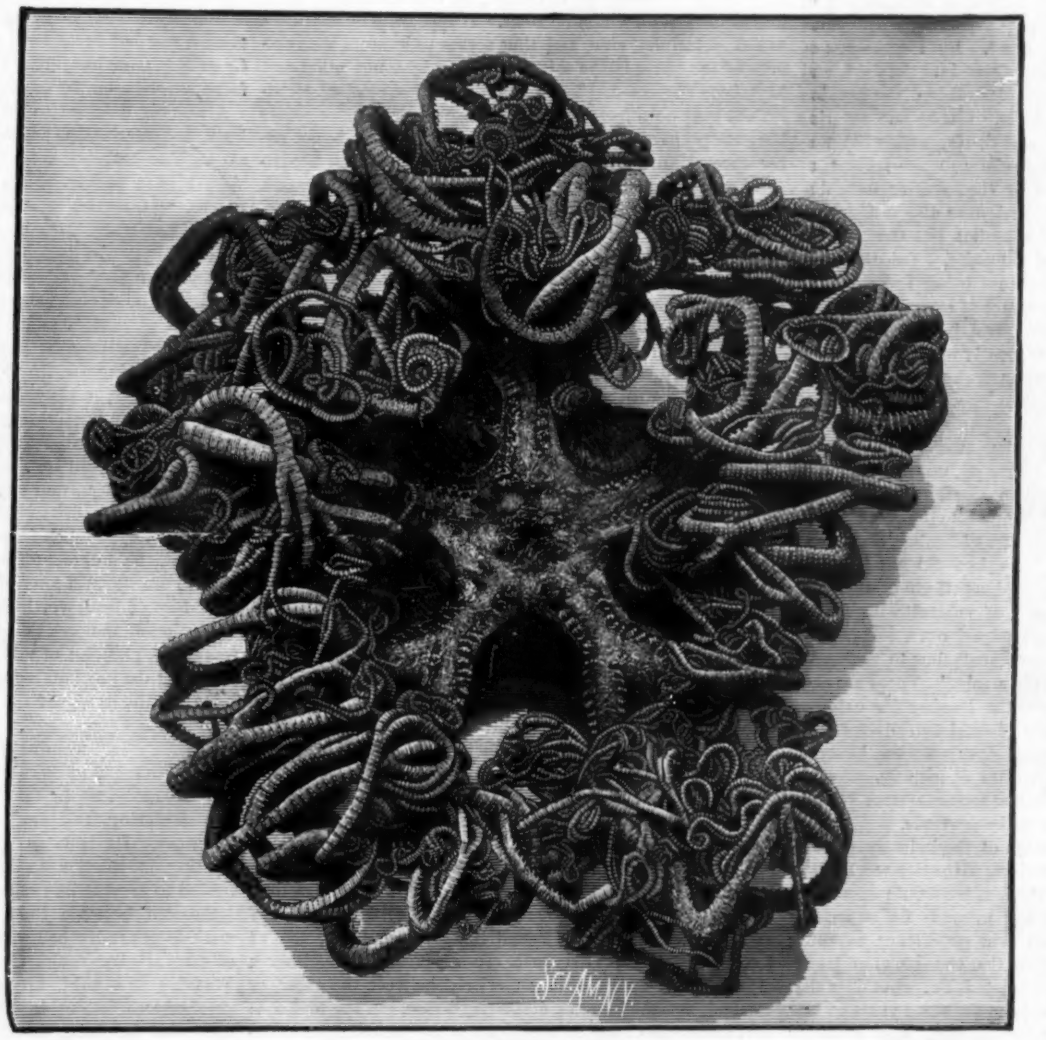
The body of *Astrophyton Agassizii* is a pentagonal disk, surrounded by arms. The disk, as measured by me in a single specimen, has a diameter of two and three quarters inches; and one of the arms is, in its entire length, nine inches, but as it lies coiled up, like a basket, it is about eight inches across the whole. The size varies with age, but the above is about the average, many being less than half as large, and others twice as great. The upper side of the disk has ten radial ribs bearing short, blunt spines. The mouth is on the under side, and central. It is set with spiniform bristles hiding twenty-four thorn-like teeth. From around the star-shaped mouth branch five stout arms, each of which is divided at the edge of the disk. The animal is wholly covered with an epidermis, granulated above, but smooth beneath, except that it seems to have a double line of stitches under each arm. The general color is light buff; but the inter-brachial spaces in the living animal vary from dark purple to bright pink.

The constant division of each arm at regular intervals into two smaller ones is a most remarkable peculiarity of the *Astrophyton*. Each of the five main branches is divided into two, making ten in all; each of the ten is divided, making twenty—and so indefinitely down to the least visible filament. Winthrop counted 81,920 of these "small sprouts, twigges, or threds."

The statement seems incredible. But take a single branch and count its bifurcations. There are fourteen. A simple arithmetical process shows that there are then 40,960 arms. Had there been one more fork, that number would have thus been doubled to 81,920, as Winthrop has said. No doubt the number is doubled again in larger specimens. One can readily see that it is not easy to represent pictorially such a living labyrinth; and the difficulty is increased by the fact that, on capture or disturbance, the creature instantly folds its more than Briarean arms closely about its body, shrinking from the touch like a sensitive plant, and assuming the basket shape from which it gets its familiar name. The attempt to untwist these coils generally ends in breaking the delicate but tenacious threads.

Last summer I had a rare opportunity for examining living *Astrophytons* while on board the steamer Speedwell off Cape Cod. Thousands of rare and curious marine specimens were obtained by steam dredging for the U. S. Fish Commission, under the superintendence of Prof. S. F. Baird, and the special direction of Prof. A. E. Verrill. Sometimes only a few basket fish would come up clinging to corals and sponges. Again, a few more would be scattered through a netful of flounders, skates, and fishing frogs. But after one memorable cast of the great trawl (17 feet wide and 50 long), there were hauled in an immense number. The water was 200 feet deep, and long before the beam of the trawl emerged, the golden gleaming of the *Astrophytons* was visible through the green waves. The weight was so great that a special lifting apparatus had to be put beneath to keep the net from breaking. As the huge mass lay writhing on deck, the sailors and others eagerly picked out the specimens most easily disengaged from the net and from one another. After about one thousand of all sizes and varieties had been secured, we grew weary of the work, and the remainder were torn off in clusters and mats and thrown overboard, and the fragments scooped up with shovels. The entire number was estimated at fully 5,000. The trawl had been dragged over one of their favorite places of resort; or they may have the custom, ascribed to star fish, of rolling themselves together in a ball and floating with the ocean currents, and in that case we must have captured an entire colony.

The basket fish is a voracious feeder, and its peculiar construction aids it in taking its prey. The microscope shows each arm and spine to terminate in a minute but sharp hook. According to Agassiz, the animal, in moving, lifts itself on the extreme end of its long arms, standing as it were on tiptoe, so that "the ramifications form a kind of trellis work all around it, reaching to the ground, while the disk forms the roof." This latticed bower is but a cruel trap for entangling heedless little fishes and shrimps, whose escape from those deadly coils is as hopeless as the efforts of a fly to break loose from a spider's web.



THE BASKET FISH.

Professor Huxley on Snakes.

The opening lecture at the London Institution for the season was lately delivered by Professor Huxley, F.R.S., to a very crowded audience, his subject being "Snakes," than which, he said, there were, in the popular apprehension, few animals more symbolical of degradation and horror. Quoting the primeval curse in Genesis, he remarked that no creatures seemed more easily destroyed by man, and few less able to defend themselves. Few wounds would be less harmful than a snake's bite were it nothing more than the sudden closing of the teeth. Yet there were not many animals gifted with so many faculties. It can stand up erect, climb as well as any ape, swim like a fish, dart forward, and do all but fly in seizing its prey. The destructiveness of snakes to man was illustrated by the fact that 20,000 human lives are yearly lost in India by their poison, and it might safely be said that they are a more deadly enemy to our race than any other beasts of the field. Professor Huxley spoke first of the three classes indigenous to our own climate—the ringed snake, the coronella, and the viper. Of these the viper alone was venomous, which the differences between its structure and that of the harmless British snakes helped to explain. It might be that the reason there were no snakes in Ireland was the multiplicity of its other plagues. Everybody must be struck with the beauty of the harmless snakes, which formed the overwhelming majority—especially the grace with which they wreathed their bodies into circles, and their fine eyes. The venomous snakes were not so beautiful. None admired our native viper, with its yellowish scales. To adults its bite was far seldomer serious than to the young. Passing to snakes in general, of which there were many hundreds of distinct species, the lecturer illustrated in great detail the adaptation of their organization to its manifold work. Very graphic was his description of the manner in which some of the more destructive snakes dart suddenly on their prey, twisting themselves round its body, crushing it into a shapeless and writhing mass, and at last swallowing it whole. He pointed out some very curious arrangements in the anatomical mechanism and jaw bones illustrative of the statement that the snake cannot properly be said to swallow his prey; he holds on to it rather, gradually working it down its throat in a most leisurely manner, but never letting it go. He would take a sleep for six weeks before giving up his task, and if the morsel were really too big would sometimes die in the effort to get it down. Of course, the snake required a very fully-developed and effective apparatus of salivary glands for this purpose. The poison bag of the venomous snakes was nothing but a modification of the salivary glands of the harmless species, the structure of both kinds being in almost all respects not only parallel throughout but almost identical. As another instance of the close relationship, it was shown that the sharp channel needle which conveys the poison of the cobra and its congeners is nothing but the development of the tooth which these murderous reptiles possess in common with innocuous snakes. The fact that the salivary gland was the poison laboratory of the deadly snakes, as well as the known properties of the saliva of dogs or other living creatures affected with rabies, appeared to Professor Huxley to point out the direction in which lay the solution of the difficult problem of the cause of snake poisoning, and of a possible antidote against it. At present there was no man living who could heal the bite of the cobra, except by cauterization in very fresh cases.

Jet.

The mineral itself is nothing more nor less than a species of pitch coal, found in detached masses, grained like wood, splitting horizontally, light, and moderately hard. It is often confounded with "cannel" coal, but it is quite distinct. Cannel coal is much harder than jet, has no grain, and splits in any direction. Jet is not easily fused, and requires a moderately strong heat, burning with a fine, greenish-white flame, and emitting a bituminous smell. The particular value of jet is, of course, its susceptibility for taking on a fine polish. Jet abounds more or less all over the world.

In England it is found in greatest quantities in the neighborhood of Whitby, in Yorkshire. There it is mixed with bitumenized wood and coniferous trees in the upper lias or alum shale of the district. In Prussia it occurs in association with amber, and is named by the amber diggers "black amber," a phrase which seems to have traveled to Italy, for the mineral is there sometimes called "ambra nera." This term is more applicable from the fact that jet, like amber, becomes electrical by friction.

There is a belief that amber and jet come from one source: that amber is a fossil gum, while jet is the trunks and the branches of the trees more completely bitumenized and freer from earthy impurities than cannel and other coal. Indeed M. Magellan goes so far as to say that jet is a pure amber, differing only in color from the undisputed variety. In France large quantities are found in the department of the Aude, where a large number of artisans find steady employment in fashioning it into rosaries, religious beads, and ornamental trinkets when fashion demands them. In Spain jet of a very high quality is found at Villaviciosa, in the province of Asturias, and is manufactured principally at Oviedo.

But during the present century jet became a popular ornament, and now probably in not a few minds Whitby and jet are inseparably associated. The article acquired considerable value, and some twenty years ago jet ear-rings ranged in value from 5s. to 30s. a pair. Then a lucrative trade was carried on at Whitby, jet miners scooped out pits in the pretty Cleveland hills, and a large number of men and young women in Whitby found employment in carving the precious coal into articles of feminine ornament. But the success of the English jet trade brought competition into the field, and with it imitation, which latter first demolished the genuine jet trade and then committed suicide. Cheap and inferior jet was imported from France and Spain, and what was wanting in value with regard especially to the former of these was amply compensated for by the superior taste displayed by the French artists in designing the ornaments. Then colored glass invaded the jet market, but the greatest blow of all was the invention of vulcanite. Vulcanite is a simple compound, its only components being India rubber and sulphur, combined by the pressure of steam. This substances has many advantages over real jet. It is equally black, more tenacious, and consequently more suitable for watch guards. It is also more easily worked, being manipulated while hot, and is not more than one-tenth the price of jet.

Vulcanite became the rage for a time, and jet fell into disuse. But the manufacturers of vulcanite, not satisfied with their victory over genuine jet, fell into evil ways, and succumbed to the great temptation to adulterate the genuine vulcanite. The addition of *litharge* and whitening cheapened the vulcanite considerably, and for a time did not interfere with its appearance; but the pernicious effects of the alloy soon tells, and the "jetty black" of vulcanite turns to a faded green. The vulcanite rage passed over, and fashion in its reaction from the somber ornaments flew to the opposite extreme, and set up a "silver mania." There are now signs that this is on the wane, and the leaning for oxide of gold, by which the rapid transition from jet to silver among the masses was slightly interrupted, does not seem likely to come into favor again. In this state of matters, says the *Colliery Guardian*, comes the announcement from Whitby that there are signs of a revival in the jet trade.

The indications of a resuscitation of the industry are certainly tangible, but while not desiring to throw a wet blanket on industrial hopes of any description, we would venture to question whether there are any real grounds for supposing that the manufacture of jet will ever experience anything like a real revival. It may be true that the stocks of jet ornaments at Whitby are being exhausted, but what does that prove? The fact is that jet has been for some years so low in value as to be hardly "worth keeping," and probably hardly worth carrying away. Ear-rings which in the halcyon days of the jet trade would have fetched 30s. a pair, retail price, could, during recent years, have been had for 5s., and what were 5s. ear-rings formerly are now worth about 2½d. The case is the same with vulcanite, and an ornament of this composition which might have cost 2s. ten years ago, could now be bought for 1d. or 1½d., and should fashion in its caprice lend a favorable eye to "black jewelry," and jet consequently acquire an increased value, that moment would the market be flooded with vulcanite. How cheap soever jet ornaments may be made, vulcanite will undersell them, and as vulcanite looks equally well, is more durable because less brittle, and is in many respects superior, any resuscitation must be ephemeral, and the sparkling coal from Whitby must succumb before a bare preparation—a fact more galling than that which befell "The Ielt or marble farre from Ireland brought," which yielded in Spenser's imagination to the "Stone more of value, and more smooth and fine."

NATURAL HISTORY NOTES.

Origin of the Name "Puss."—Says the editor of the *Zoologist*, the cat was worshiped in Egypt as a symbol of the moon, not only because more active at night, but from the priests conceiving that the contraction and dilatation of the eye afforded an emblem of the increase and decrease of the moon's ever-changing orb. In the British Museum may be seen several figures of the cat-headed goddess Pasht, under which name the moon was worshiped by the Egyptians—Pasht signifying the face of the moon. "Pasht" is compounded of the consonants P, SH, T. T is the coptic feminine article, which, being omitted, the same is reduced to P, SH, but the aspirate SH should be the tenuis S, and then the word would be PS, as in Hebrew, and which may be pronounced "pas" or "pus" (puss). It thus appears that our familiar name for the cat can boast of a very high antiquity.

A Grass Fatal to Sheep.—One remarkable fact connected with the botany of Queenstown is, that a grass, which grows locally abundant in the more northern portions of the colony, *Aristida hygrometrica*, is fatal to sheep by reason of its long, sharp, tripartite awns getting entangled in the wool and ultimately piercing the skin and penetrating to the viscera of the thorax and abdomen, causing death after prolonged wasting and suffering; the heart, liver, kidneys, etc., are sometimes, on dissection, found pierced by these mischievous awns in all directions.

The Influence of Soil on Plants.—Sufficient attention, perhaps, has not been paid to the study of the influence of soil in producing variation in plants, and changes and modifications of their constituents. A writer in the *Pharmaceutical Journal* has recently called attention to the fact that it is rare to find the *Viola odorata* with blue flowers on a calcareous soil in England, the prevailing color being white. One of the genus of violets has lately been examined by Dr. König, who finds as much as 21 per cent of zinc oxide in the ash of the plant. This violet is so distinct in appearance that it has been considered a good species by some botanists, and called *Viola calaminaria*. But by most authorities it is regarded as a variety of *V. tricolor*, its characteristics being due to the soil on which it grows. It appears to be restricted to soil containing zinc, and thus serves to indicate the presence of the metal in the soil, where it might not otherwise have been suspected. The extent to which medicinal preparations may be affected by the soil upon which the plants they are prepared from have grown, is illustrated by an experience of M. Gérardin, pharmacien, in the Marne department. Having prepared some extract of belladonna from a defecated juice, he found it after some weeks full of granulations. These proved to consist of a mixture of silicate and chloride of potassium equal in weight to 6·8 per cent of the original extract. It was then remembered that the belladonna plants used had been collected from a spot which had long been frequented by charcoal burners for their operations, and the remainder of the explanation was to be found in the decided fondness of solanaceous plants for silica and potash.

Changing the Color of Feathers in Live Birds.—It is stated in Kidder and Fletcher's "Brazil" that the Indians have a curious art by which they change the color of the plumage of many birds. They pluck out a certain number of feathers, and in the various vacancies thus occasioned infuse the milky secretion made from the skin of a small frog. When the feathers grow again they are of a brilliant yellow or orange color, without any mixture of green or blue, as in the natural state of the bird; and, it is said, the yellow feather will ever after be reproduced without a new infusion of the milky secretion.

Leaf Structure.—Long ago Nehemiah Grew published some very accurate drawings of the structure of leaves and leaf stalks—so far as the disposition of the fibrous tissue is concerned. Quite recently M. Casimir De Candolle has investigated the same subject with special reference to the distinction and resemblances to be drawn between allied species of the same family. It is found that different species of the same genus sometimes accord, but sometimes differ notably in this part of their anatomy. For this reason the classificatory importance of these differences is low, although they may often be turned to good account in the discrimination of related species. The essential fibro-vascular system of the petiole, as displayed on a cross section, forms either a closed ring or an arc open superiorly between the outer or cortical, and the inner or medullary tissue. In the first case it is said to be closed or complete, in the second open or incomplete. Very commonly this is the only vascular system of the petiole, ribs, or veins. Not rarely there are additional or accessory bundles, sometimes external to the essential system, or *intracortical;* sometimes within the arc or ring, or *intramedullary;* occasionally there are both intracortical and intramedullary bundles. Generally plants of the same natural order will agree, at least approximately, in having the closed or open system, and in having or wanting the accessory bundles without or within. But while *Acer pseudo platanus* has a well developed intramedullary cord, *A. platanoides* has none, and in general the maples are divided in this respect quite independent of other characters; and the difference is similar and equally marked between the species of *Æsculus*. The oaks, which have been made a special study in this regard, appear to be somewhat equally divided between species provided with and those destitute of intramedullary bundles; but related species generally belong to the same category, although not always. For in one case two species, of doubtful distinction until now, are confirmed by the discovery of an anatomical difference of this sort. All the birches examined want the intracortical bundles, and the principal system forms an open arc, and one or two alders nearly agree with them; while the others have a closed ring and are furnished with intracortical bundles.

Barometric Plants.—Linnæus, in his "Flora Lapponica," writing on the white clover *Trifolium repens*, states that it is a common practice to predict a coming storm by an inspection of this plant, for when the air is hot then the leaves hang down, whereas when there is moisture in the atmosphere the leaves are erect. This observation, he remarks, holds good not only for the clover, but also for almost all plants which have declinate stamens. All the flowers, too, he adds, generally converge when a shower is impending, as though they knew that the water would interfere with the fertilization of the plant, for when the fertilization has been effected no such convergency is exhibited. He instances *Mimosa, Cassia, Bauhinia*, and their allies, as plants whose leaves converge every evening, even though there be no diminution of temperature, and concludes by asking the still unanswered question, What is the cause of this sensitiveness, and what change is there in the night air beyond the absence of light and heat? Dr. Hooker states that the leaflets of *Oxalis* are pendulous at night, and often sensitive to light. Of *Anagallis arvensis* he remarks that the corolla opens in clear weather, and a number of plants besides those specified exhibit the same phenomenon, and doubtless obey the same law. What is this law?

Some Facts about our Territories.

The annual report of the Secretary of the Interior contains a large amount of information with regard to the present condition and future prospects of our Territories, furnished by their respective Governors. The more important facts are as follows:

UTAH.

The snows which fall in the mountains and remain there during the summer provide the main supply of water necessary for irrigation. During last winter but little snow fell, hence the short supply and the deficiency in the crops. Some of the largest streams in the Territory have gone dry, something never before known to the oldest settlers. Even the Great Salt Lake has fallen four or five feet. Stock has suffered severely on the mountain ranges.

Attention is called to the defects in the present mining laws, and suggestions are made as to the amendments necessary. The Governor holds that "a man's patent to his mine should be a perfect title to the property covered by his patent, and parties purchasing patented mines should be required to trace titles no further than to the patentees." He also favors the granting of a larger surface area, and the confinement of rights within the lines granted. In other words, a mining claim should be as definite, so far as boundaries go, as that of a city lot, and the right to work should be confined within the perpendicular lines of its side and end. Following the dip of mineral veins on the ground of other parties is, in his opinion, the fruitful source of litigation. The mining interests of Utah are reported as in a most excellent condition; the introduction of new methods of reducing ore causing larger profits to be realized than were possible in former years.

From the year 1870 to 1878, inclusive, the Utah board of trade reports, as taken from the books of the Utah Central Railroad, the shipment from Salt Lake City of 76,912 tons of lead ore, 109,276 tons of argentiferous lead bullion, and 8,197 tons of lead, worth in the aggregate about $40,000,000. The value of the ores taken out during the past three years was $18,558,805.48; of this $[illegible],379,446 was lead, the remainder being the precious metals.

During the past year 150 miles of additional railroad have been built.

WASHINGTON TERRITORY.

The Governor of Washington Territory reports satisfactory advancement in the development of the agricultural, manufacturing, mining, and commercial resources of the Territory. Its isolated position and the misconception existing in relation to its climate and productions have tended to prevent its rapid growth.

Situated between the 46° and 49° north latitude, its climate is generally believed to be cold, and yet the results of careful observation show that the climate of Western Washington is mild, during the winter months the temperature seldom falling below the freezing point. A tabular statement is given, showing the character of the climate throughout the year, based on accurate meteorological observations taken at Port Blakeley, on Puget Sound, in latitude 47° 36'. It would appear from this statement that the lowest temperature during a period of twenty-six months was 25° above zero. The highest in 1877 was 88°; in 1878, 94°; and in 1879, 86°.

The average rainfall is about the same as in the Eastern and Western States. The mildness of the climate is due to the presence of the thermal current, having its origin at the equator, near the 130° east longitude, Greenwich, and which flows northwardly to the Aleutian Islands, where it separates, one branch flowing eastwardly, along the peninsula of Alaska, and then southwardly, along the coast of British Columbia, Washington Territory, and Oregon. The prevailing winds during the winter are from the southwest, and those of the summer from the northwest.

The temperature of Eastern Washington as compared with the western division is slightly higher during the summer and lower during the winter. The average annual temperature is reported as follows: spring, 52°; summer, 73°; autumn, 53°; winter, 34°.

All the cereals, fruits, and vegetables grown within the temperate zone can be raised in Washington Territory. Eastern Washington is the great wheat field of the Territory, with a capacity for upwards of 100,000,000 of bushels. The average yield is 25 bushels to the acre.

The exportation of wheat during the present year will be upwards of 60,000 tons. Transportation facilities are inadequate to the demand, and will so continue until the obstructions are removed at the Dalles, Cascades, and other points on the Columbia River.

The exports of the Territory have been the cereals and wool, flour, live stock, canned salmon, fish, lumber, coal, potatoes, hops, hides, barrels, lime, etc. The export of coal during the year was 190,000 tons; lumber, 150,000,000 feet; salmon, 160,000 cases of 48 cans each, or a total of 7,680,000 cans.

The population of the Territory on the first of May last was 57,784, an increase of 7,273 over last year.

NEW MEXICO.

The three leading interests are mineral, grazing, and agricultural; manufacturing is confined almost exclusively to jewelry, of which very exquisite work in filigree is produced in Santa Fé, mostly from gold and silver native to the Territory.

But little advancement has been made in agriculture. Its present condition is very primitive, the old Mexican wooden plow still holding preference with the farmers. The little produced is with a view to satisfy local consumption. Wheat and oat fields, as rich as any in Illinois and Minnesota, may be seen six or seven thousand feet above the level of the sea. The grape is easily raised, is free from disease, and affords a good quality of wine. The area of agricultural production cannot be even approximately given. All irrigable lands, wherever found in the Territory, may be classed as productive or farming land.

The Rio Grande Valley, about four hundred miles in length by an average of five in width, has a soil light, warm, and surpassingly rich. Not more than one tenth of this land is occupied. Fruits succeed admirably in this locality, although the varieties at present cultivated, except the grape, are of the poorest kind. The valley of the Pecos River is almost entirely devoted to grazing purposes. Like the valley of the Rio Grande its soil is rich when properly irrigated, and its climate healthy and delightful. The Mesilla Valley, like the two mentioned, is inviting both for agricultural and grazing purposes. The vast tracts of table lands bordering the valleys are too high for irrigation, but yield grasses of the richest kind for cattle and sheep raising. With such unlimited ranges, stock raising has become a profitable industry, with promise of substantial growth in the future.

In relation to the mineral resources, the governor is of the opinion that New Mexico will compare favorably with her neighbors in the yield of precious metals. Although the era of prospecting has hardly given place to that of development, enough is already known to warrant the assertion that the Territory is well stored with gold, silver, iron, copper, lead, zinc, mica, gypsum, coal, marble, and precious stones. The coal croppings in Socorro and Colfax counties, and on the Galisteo River, indicate an inexhaustible supply both of bituminous and anthracite. Cannel coal is also found in the Territory. No attention is being paid to the production of iron, although it is to be found, more or less, in every mountain range. The same may be said of copper, lead, and mica, while gypsum is so common that it is hardly a merchantable commodity. Silver and gold are to be found in many localities, and many mines are being worked to advantage. The great drawback at the present time is the want of water.

Mention is made of the numerous hot springs in the Territory. The waters of many of these have well determined curative properties, and at Las Vegas elaborate preparations are being made for the care and entertainment of guests and invalids.

An approximate estimate gives the territory a population of 125,250. The Pueblo or town Indians are estimated at 9,000 and the wild Indians at 14,500.

The report concludes with a statement giving the results of certain observations relating to the climate of the Territory. From this it would appear that the central portion has a delightful and healthy climate. The prevailing diseases are rheumatism and catarrh, while consumption is almost unknown.

DAKOTA.

Dakota is the largest of the organized Territories, containing about 150,000 square miles, or an area nearly equal to Pennsylvania, New York, and all the New England States combined. The Governor reports the present year as one of unexampled prosperity. Although the crops in some of the southeastern counties were partially destroyed by drought and grasshoppers, those of other sections have been excellent.

The products of the Black Hills mines are estimated at $3,000,000 for the past year. Immigration has been larger than in previous years. In the absence of accurate returns, the population of the Territory can only be approximately given at 160,000.

Railroad facilities are being largely increased, about 400 miles being already completed, with a promise of at least 500 miles by January.

The Governor favors the division of Dakota, and is of the opinion that two or three Territories could be advantageously formed out of the present area.

IDAHO.

The year has been one of thrift and prosperity. Agriculture and mining have been remunerative, schools have been encouraged, and good health has prevailed. With the advent of railroads and improvements in highways a large immigration may reasonably be expected.

The numerous streams of Idaho afford facilities for irrigation in those sections where rain is infrequent, while the lands of Northern Idaho can be cultivated without resort to artificial means. The Governor describes the methods employed for irrigation and the encouraging results which ensue therefrom. He favors government aid in the effort to reclaim lands for cultivation, and the adoption of some system by which large tracts may be secured by individuals willing to expend their capital in building the necessary works for irrigating purposes.

The timber supply of the Territory is abundant, but a reckless disregard for the public interests has marked its destruction for years past. In addition to the waste of timber by man, the fires which constantly sweep the mountains destroy a greater amount than is taken for consumption by the entire population.

Since 1863 the gold and silver product of Idaho has amounted to about $67,000,000. As there is no law requiring miners or public officers to make returns, only approximate estimates can be given. The improved methods employed in reducing the ores and the increasing facilities for transportation will in the future largely augment the annual yield of the precious metals.

The mining laws especially need revision; and in the Governor's opinion Congress should pass a comprehensive and carefully revised act, covering the mining field, clearly defining all rights and remedies, and leaving but little scope for local legislation. It is also suggested that Congress interpose for the protection of agricultural interests by preventing the monopoly of the streams of the Territory by private individuals or corporations. The usufruct of natural streams should be guarded by stringent laws, so that the water needed by the many should not be monopolized by the few.

The finances of the Territory are reported to be in a satisfactory condition, and the debt of the Territory is gradually being reduced.

No reports had been received from the Governors of Arizona, Wyoming, and Montana.

Kansas Natural Lime.

Among the natural products, some of them possessing very peculiar characteristics, which the young and growing State of Kansas contains, is a singular substance, lying in very considerable beds, and called "Kansas native lime." It is, says a correspondent of the *American Architect*, of a beautiful white color and of a very fine-grained texture. It is soft, smooth, and readily made into a plastic condition by the admixture of a suitable quantity of sand and water. The mortar thus made up has seemingly identical qualities to the best mortar as made from superior limes selected from kilns where the lime rock which had been employed for burning had been of the very purest nature.

The native lime is a sort of whitish and pure white clay, lying disposed favorably in beds more or less horizontal in their position. These beds are seen to be outcropping along the borders of certain streams and in the breaks of hills, and in such places the beds can be worked entirely above the water level. Experiments which have been performed by workmen and artisans in Kansas have exhibited the fact that Kansas lime mortar serves as good purposes as any other usual styles or kinds of mortar, and even better than some of the artificial mortars, especially for nice inside work. The tendency of this newly discovered deposit of pseudo-lime, when made into mortar for walls and stonework or plastering, is to soon set and harden. Another remarkable quality then noticed is its turning immediately to an intense whiteness. The beds are very thick and easily dug; so that large quantities of the substance can be thrown up, and at once applied to use. Beside its ready adaptability to purposes of mortar, it has also been applied to the purposes of whitewashing, and in this respect it has been accepted as an admirable substitute for lime prepared artificially. These immense beds of pseudo-lime occur in localities where railways of Eastern Kansas can readily be utilized for shipping the material to all parts of the country. It is, perhaps, presumable that upon the spread of the knowledge of this fact, the excellent natural mortar lime and whitewash lime from these native deposits may become articles of export, especially as improved styles of building and more permanent structures everywhere in Kansas, Missouri, Nebraska, Iowa, and Illinois are growing to be more and more the requisites of the times. The great pseudo-lime beds or native beds of calcined lime rock are a geological phenomenon. They are difficult to account for in any plain or obvious manner. They have a close resemblance in their physical condition and looks, and in their feel or touch, and in their action when mixed to form mortar, to the best mortars made in the usual ways with the very best of limes. Can it be possible that some of the unknown laws of electro-magnetism and of terrestrial magnetism, which cause certain metamorphisms to occur in metalliferous beds, are likely to be discovered as the laws also which set the elements at work to alter the chemical conditions of this singular lime rock stratification? Can the problem of their origin and nature be clearly or satisfactorily accounted for in any other way? Does such a strange product as this occur in any other section of our continent?

Bad Work Makes Bad Trade.

The statistics of railway accidents during the past year in England, among which were 937 failures of tires, 346 failures of axles, and 1,377 broken rails—leads a London writer into a strain of moralizing which may contain some sound warnings, if not practical lessons, to American manufacturers. He says: "Two thousand six hundred and seventy three flaws and failures in wheels, couplings, and rails. Any one of these sufficient to cause a fatal calamity. No more shameful illustration of the way in which English manufacturers have been meeting competition could be put forth. Bad iron, ill-worked steel, and 'scamped' workmanship; these are the chief causes of the 'failures' in tires and axles and rails. It has become quite an old story, unfortunately, this relaxation of honest pride and commercial honor during the last few years. Loaded cottons, shoddy cloths, rotten iron, ill-tempered steel, poorly ground cutlery, short weight, and adulteration of all kinds have taken the place of the genuine English goods by which the old country had made her reputation. Masters driven to despair by trades-unions and strikes, by prohibitory tariffs abroad, have laid down their old-fashioned honor and put size into their calico, rags into their cloth, worthless 'brands' of raw material into their tires and rails, third-class goods into first-class wrappers; and so trebled the speed with which commerce has been running down the hill of stagnation. One of the best signs of the day is an occasional outspoken acknowledgment of the absolute necessity of turning out once more genuine goods, the utter, absolute necessity of rehabilitating the English name in the markets of the world, and it must be said for many solid old firms that they have never sacrificed their reputation by a reckless attempt to meet exceptional times and competition. It has, nevertheless, been a common thing for Sheffield to take inferior foreign goods and finish them, more particularly by putting a local trade-mark on them 'for a consideration,' thus lowering the standard of Sheffield goods. Time was when the woodmen and farmers of America and the Colonies would use nothing but Sheffield axes. It is not only the splendid character of American manufactures in this direction, but the turning out of bad work under Sheffield trade-marks, that has made the American ax popular not only elsewhere, but here in England. An English saddle used to be regarded as the acme of strength and perfection; but Prince Napoleon lost his life through the giving way of a portion of his saddle fixings, the bad workmanship and material of an English manufacturer. Sad lessons these! They are being laid to heart by many traders, and it is believed that with the present improvement in business some regard will be paid to one feature of the moral of our national misfortunes. Here and there the workingmen seem unwilling to co-operate with the employer in meeting the new demands; but, on the other hand, there are evidences of an earnest desire to make the most and the best of the trade revival."

Hitherto American productions have won their way by honesty of workmanship not less than superiority in practical fitness. It is sincerely to be hoped that whatever may be the results of the increasing competition at home and abroad, any lowering the high standard of honesty thus far maintained by our manufacturers will not be among them.

Electrical Poetry.

The late Prof. Clerk-Maxwell was in the habit of recreating his mind from its severer task by penning amusing physio-comic parodies of well known poems. One of the best of these was his electric valentine, which runs as follows:

ELECTRIC VALENTINE.

Telegraph Clerk A to Telegraph Clerk B.

"The tendrils of my soul are twined
With thine, though many a mile apart;
And thine in close-coiled circuits wind
Around the magnet of my heart.

"Constant as Daniell, strong as Grove;
Seething through all its depths, like Smee;
My heart pours forth its tide of love,
And all its circuits close in thee.

"O tell me, when along the line
From my full heart the message flows,
What currents are induced in thine?
One click from thee will end my woes."

Through many an Ohm the Weber flew
And clicked this answer back to me:
"*I am thy Farad staunch and true
Charged to a Volt with love for thee.*"

$\frac{dp}{dt}$.

The inscrutable signature, $\frac{dp}{dt}$ is explained by a correspondent in *Engineering* to be adopted from the fundamental equation of thermodynamics $\frac{dp}{dt}$ = J. C. M. (James Clerk-Maxwell.

The First Year of the New York Elevated Railroads.

The report of the New York Elevated Railroad for the year ending with September last covers the first year during which the whole length of the road was operated, that is, about 8½ miles from the battery to Harlem, and 5 miles from the battery to Fifty-ninth street. In that year 29,875,912 passengers were carried, and the earnings from passengers (all the other earnings were but $4,546) were $2,233,402, an average of 7·48 cents per passenger, and about $165,540 per mile of road. The expenses of operation were $1,171,339 for "operating the road," which in the New York schedule includes all working expenses except maintenance of road and maintenance of equipment. Under these latter heads only $51,459 was expended on road and $74,458 on rolling stock—thus bearing an extremely low proportion to the other working expenses. As this was the first year of operation for most of the road, these maintenance expenses were probably lower than they will be on the average hereafter. They will doubtless always be a smaller proportion

of the total expenses than on ordinary railroads, at least for maintenance of road, because the train movement is extraordinarily great, the trains exceptionally light, and the road exceptionally durable and permanent—no ballasting to keep up, ties uninjured by bad drainage, no liability to floods, only the rails wearing out about as on other roads in proportion to the tonnage passing over them. The average *expense* per passenger carried was not quite 4 cents (3·92 cents). If a uniform fare of 5 cents had been charged at all hours, which has been strongly advocated by some of the city papers, the net profits (with the same traffic) would have been reduced from $1,068,150 to $322,660, or to little more than two thirds of the interest on the bonds. Doubtless a 5 cent fare in the middle of the day would increase the traffic considerable, but certainly not enough to make up the difference in the rate. To do that it would be necessary for the number of passengers to become more than three times as great. As the road already carries at 5 cents during the four hours when traffic always is heaviest, and when the greatest bulk of the necessary travel must be done, there would be no possibility of any such increase; but this does not prove that some modification in rates, which would fill the trains when they now run more than half empty, might not prove profitable. It now costs as much to travel a quarter of a mile on this road as to ride the 8½ miles from the battery to Harlem. On the Third avenue line, which passes through a densely peopled district where most of the residents are not very rich and many are very poor, and which passes close to some of the leading retail centers, most people would rather pay 5 cents to ride a mile, many to ride two miles, and not a few to ride three miles, on the street cars, than pay 10 cents on the elevated road. But it would not by any means be an easy matter to provide for the collection of different rates for different distances on this road.

The enormous net earnings of $79,122 per mile were all absorbed except $28,690 by the payments of interest, the 10 per cent dividends on the stock, and a payment of less than $28,000 to the city of New York as a sort of charter tax. The traffic of this road will doubtless increase (at least till the Second avenue line is opened), but it is not at all certain that the expenses will be so low hereafter, now that prices have risen and after the road and rolling stock have had time enough to wear out a little. The cost of the road and equipment is reported at just about $1,000,000 per mile; this is the cost in stock and bonds. The contract for constructing it could be, or could have been, let for cash for less than one half of that amount, doubtless.

The Metropolitan Elevated Railway has also rendered its report for the same year, during the whole of which its line from Trinity Church to Central Park was open, and during three fourths of it the line through Fifty-third street giving access to one additional important station, while later, one after the other, it was opened to three or four other stations, only one of which, however, yielded any considerable amount of traffic during the year in question. It shows for the year a profit of $576,456, while the bonds outstanding at the close of the year require $304,920 for interest, and the 10 per cent dividends on the stock guaranteed by the Manhattan Company will amount to $650,000. This, however, will cover a great deal of road not in operation last year, though it can hardly be expected to be as productive as the old road for some years to come.—*Railroad Gazette.*

Light Draught Fast Steamers.

The following particulars are given by a correspondent of the *American Ship:* Although there are many points of construction which might be adopted from Eastern steamers with advantage, on the shallow and dangerous rivers of the Mississippi Valley, it is doubtful whether their hull models could be studied with profit. Nearly all the steamers navigating the Mississippi and its tributaries are constructed upon the Ohio. The perfection the builders along that river have attained in constructing vessels of exceedingly light draught may be inferred when we state that, on any day during the navigation season, steamers, having a freight capacity of from 1,000 to 1,800 tons, may be seen at the Cincinnati wharves, which draw less than three feet light. And there are many boats plying the Upper Ohio which trim on two feet, to say nothing of the little low water "dinkies," which can almost "navigate a meadow after a heavy dew."

The Telegraph, a large passenger boat, 288 feet in length, 41 feet beam, and 6 feet hold, draws light, two feet.

The Golden Crown, a fine stern-wheel steamer of the Southern Transportation Line, running between Cincinnati and New Orleans, has a capacity for over 1,500 tons of freight, and trims, with steam up, *two feet* water.

The Mary Houston, of the same line, side-wheel, draws less than three feet, and carries 1,500 tons.

The Guiding Star, also of the S. T. Line, is over 300 feet in length, and has a capacity for 1,800 tons. She draws 33 inches, light.

The New Natchez, one of the fastest of the big palatial steamers on the Lower Mississippi, is 303 feet long, 46 feet beam, and 10 feet hold. She has 8 steel boilers 36 feet long, 43 inches diameter. Engines, 10 feet stroke, 34 inches diameter; capacity for 2,000 tons freight or 8,000 bales cotton; draws light, less than 5 feet.

The St. Lawrence, an elegant and swift Ohio river side-wheeler, is 270 feet long, carries 1,000 tons, and *draws twenty-seven inches.* The Pittsburg, stern-wheel, carries over 1,000 tons, and draws only 24 inches.

Many other steamers of equally remarkable draught could be enumerated had I the space. Many of the small stern-wheelers, navigating the bayous and small tributaries of the Mississippi, draw less than 14 inches, and yet have room for 1,200 or 1,400 bales of cotton. The most necessary improvement in Western steamers, and especially in the boats plying in long distance trades, is an increase of speed. With the exception of a few of the fast palaces on the Lower Mississippi, there are few boats that ever attain 15 miles an hour up stream, and 12 miles an hour is considered extraordinary. Such slow time is unpardonable in an age of rapid transit like this, and, as long as Western river boats continue to disregard the demands of commerce, railways will hold the upper hand in competition.

Kroh's Rapid Process.

The formulæ for Herr Kroh's rapid plates is given as follows in the *Photographisches Wochenblatt :*

To one kilogramme of iodide collodion add a quarter of an ounce (= 8·75 grammes) of the following solution: Absolute alcohol seventy grammes, and three to four grammes of isinglass or gelatine cut small and dissolved by heat in a glass containing thirty-five grammes of distilled water; then add four grammes of iodine of potassium and three grammes of bromide of ammonium, and when all is completely dissolved and filtered through a piece of linen previously thoroughly washed in alcohol, pour into a bottle capable of holding about a kilogramme and a half. To a quarter of an ounce (= 8·75 grammes) of the above solution add one kilogramme of iodide collodion and shake thoroughly for eight or ten minutes; then add from eight to ten drops of acetic ether, and the result will be the so-called "cheesy collodion."

Remarks on the Foregoing.—On the addition of the gelatine and iodine solution there is an immediate, though harmless, appearance of turbidity, and by this addition cotton is precipitated, but may be redissolved by diligent shaking. The iodizer—that is, the gelatine iodizing solution—may be varied according to the state of the light and the position of the studio. If powerful pictures are desired the following should be used:

Iodide of ammonium	4	grammes.
Bromide of cadmium	4	"
Absolute alcohol	70	"
Distilled water	175	"

If it be desired to work without intensification, and to have an extremely sensitive collodion, then take:

Iodide of sodium	4·50	grammes.
Iodide of lithium	3	"
Absolute alcohol	70	"
Distilled water	26·25	"

If the collodion be required to work rapidly, but not powerfully, then to one kilogramme of prepared collodion add 0·73 gramme of sublimed iodine. It is as well when pouring off superfluous collodion to let it run into a second bottle. Allow the plate to become *perfectly* dry before dipping it into the silver bath.

The development is effected by two developers, Nos. 1 and 2:

DEVELOPER NO. 1.

Distilled water	60 ounces	= 2·1 kilogrammes.
Ferrous sulphate	3 "	= 105 grammes.
Acetic acid	3 "	= 105 "
Absolute alcohol	4 "	= 140 "

RAPID DEVELOPER NO. 2.

Distilled water	60 ounces	= 2·1 kilogrammes.
Ferrous sulphate	5 "	= 175 grammes.
Acetic acid	3 "	= 105 "
Absolute alcohol	4 "	= 140 "
Oxalic acid	4 to 5 grains	= 0·36 gramme.

Developer No. 1 is applied cold. The rapid developer requires that the ferrous sulphate, the water, and the oxalic acid should be heated and properly dissolved in a shallow vessel; when the solution has become cold the alcohol and acetic acid are added, and then the whole is filtered. After the exposure the plate is coated with developer No. 1; when the highest lights have been brought out it is poured off, and then the rapid developer is taken, which immediately brings out the deepest shadows. If soft pictures for intensification be required then the rapid developer should remain a long time upon the plate, and a short time in the reverse case.

FIXING BATH.

Water	10 parts.
Cyanide of potassium	1 part.

INTENSIFIER.

Silver		17·5	grammes.
Distilled water	1 kilo.	35	"
Chemically-pure nitric acid		5	drops.
Pyrogallic acid		2·75	grammes.
Citric acid		1·46	gramme.
Water		560	grammes.
Glacial acetic acid		17·5	"

After drying the plates, which are not sufficiently powerful, are varnished with common varnish, and then strengthened with the above intensifier. If the plates are blue after being well washed they are coated with a solution of 5·5 grammes of cyanide of potassium in 350 grammes of water, to which from five to eight drops of the intensifying silver have been added (and well shaken) until the surface becomes a bright yellow.

SILVER BATH.

60 grammes of iodide of potassium dissolved in 70 grammes water.
25 " " nitrate of silver " " 420 " "
8 to 10 drops of the iodizing solution given above.
2 drops of nitric acid.

The bath may be used the second day. The photographer is recommended to prepare three silver baths, and to use a different one every day for three days and then recommence, so that each bath is only used one day in three. In studios where from twenty to thirty sittings are given daily six baths will be required. Time of floating, three minutes. The duration of the exposure should, with a good light, be three-quarters less, and with a bad light a half less, than by other processes.

The Erie Canal.

In a recent letter to the New York *Tribune* urging the deepening of Erie Canal, Mr. T. C. Ruggles says:

The reasons why steam has not succeeded better on the canal are, first, the steamer was not long enough; it required either more length itself or another boat to push; and next, the bottom of the canal was not finished to its proper width of fifty-six feet, and to a depth of seven feet for this width at the bottom, so that two loaded boats could easily pass each other. The only way to do on the canals, as the locks would not admit longer boats than those now in use, was to fasten one boat before the other, taking them apart at the locks. This, in fact, has doubled the capacity of the steamer, and enabled the same crew to bring down twice the load for the same price, and has made steam a success. The State Engineer, the Hon. Horatio Seymour, Jr., recommends deepening the canal one more foot; but eight feet deep, though a great aid, will make but little difference in the cost of transportation (about one quarter of a cent a bushel), and no difference in time. If steamer and consort are each to be loaded forty more tons, they will be so deep in the water that there will be but a few inches between the propeller wheel and the bottom of the canal; consequently the steamer and consort will not go over two and half miles per hour, or be eight days from Buffalo to New York. Three feet deeper, with the canal banks raised one foot, will reduce the time to New York to four and one quarter days, instead of eight, and the cost of moving a bushel to one and three quarter cents.

The cost of deepening the canal one foot is estimated by Mr. Seymour at $1,100,000. From 1868 to 1876 the canal reduced the tolls from six cents a bushel to two cents, but made no improvements in reducing the cost of transportation. The New York Central in the same time was constantly improving its means of transportation. In 1875 and 1876 this road expended $3,849,270 for depots, engines, superstructures, etc., for the purpose of expediting and cheapening its transportation. The following is the comparative result of the canal and railroad policy:

In 1868 the canal moved tons one mile	1,033,751,268
In 1876 the canal moved tons one mile	570,969,064
Loss	462,782,204
In 1868 the railroads moved	366,199,786
In 1876 the railroads moved	1,674,447,055
Gain	1,308,247,269

The canal lost in eight years nearly half its tonnage, while the railroad in eight years nearly quadrupled its tonnage.

The White Wax of Sze-chuen.

Describing some curiosities of trade in China, the *Pall Mall Gazette* gives a number of interesting facts with regard to the production of the white wax of Sze-chuen.

In the Keen-chang district of that province there grows in abundance the *Ligustrum lucidum*, an evergreen tree with pointed ovate leaves, on the twigs of which myriads of insects spread themselves like a brownish film, in the spring of each year. Presently the surface of the twigs becomes incrusted with a white waxy substance secreted by the insects, and it increases in quantity until the latter part of August, when the twigs are cut off and boiled in water. During this process the wax rising to the surface is skimmed off, and is then melted and allowed to cool in deep pans. By one of those curious accidents which have done so much to increase the knowledge of mankind, it was discovered that by transporting the insects bred in Keen-chang to the less congenial climate of Kea-ting Fu, in the north of the province, the amount of wax produced was vastly increased. No people more readily discern a commercial advantage, or more speedily take advantage of one when unencumbered with political considerations, than the Chinese; and this singular effect of removing the insects from a congenial climate to one so uncongenial as to prevent their breeding was eagerly taken advantage of by the Sze-chuen traders. Travelers by night on the high road between Keen-chang and Kea-ting Fu may meet in the spring of the year hundreds of wax merchants, each carrying his load of female insects, big with young, on their way to the wax farms in Kea-ting Fu. The journey is rough and long and a fortnight's sun would precipitate the hatching, which should take place after the females have been attached to the trees. To the unscientific eyes of Chinamen the round pea like female appears to be nothing more than an egg, and this belief is the more excusable since the birth of the young is the signal for the death of the parent, of whose previous existence there remains only as evidence an outer shell or husk. Six or seven of these prolific mothers are wrapped in a palm leaf and tied to a branch of the *Ligustrum lucidum.* In a few days swarms of infinitesimally small insects creep forth and cluster on the twigs of the tree, where they fulfill their mission and perish with its accomplishment in the boiling pot each August. Baron Richthofen considers the value of the annual crop to be on an average upwards of $3,000,000; and during last year there was exported from the one port of Hankow upwards of $400,000 worth of it.

NEW INVENTION.

Mr. John Rogers, of Eldridge, Iowa, has patented an improved harrow, in which the frame is made in two parts, an upper and a lower, connected together and fitted to move lengthwise upon each other. The teeth are pivoted upon the upper frame, and pass through apertures in the under frame, so that the inclination of the teeth is dependent upon the relative position of the two parts of the harrow.

Business and Personal.

The Charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

☞ The publishers of this paper guarantee to advertisers a circulation of not less than 50,000 copies every weekly issue.

NEW BOOKS AND PUBLICATIONS.

CONTRIBUTIONS FROM THE E. M. MUSEUM OF GEOLOGY AND ARCHÆOLOGY OF PRINCETON COLLEGE. No. 2. Topographic, Hypsometric, and Meteorologic Report. By William Libbey, Junior, and W. W. McDonald, of the Princeton Scientific Expedition of 1877.

With these reports are three maps: the first containing the results of a topographical reconnoissance of the valley of Smith's Fork, in the Uintah mountains of Utah; the second containing the triangulation of the same region; the third showing the country between Fort Bridger and the Uintah mountains. The meteorological and topographical work was confined mostly to this region. The only work of scientific value done in Colorado was hypsometric. The report is embellished by a number of admirable artotype prints from photographs of typical scenery in Colorado and Utah. For students' work the entire report is decidedly creditable, and speaks well for the instruction given in the college.

DICTIONARY OF COMMERCE AND MANUFACTURES. By L. de Colange, LL.D. Boston: Estes & Lauriat. 1 vol. quarto, pp. 1,200. Published in 25 parts. Each 50 cents.

The first four parts of this dictionary (A1 to Cologne Water) cover a wide range of subjects, and contain much useful information. The compiler, however, does not seem to have had access to the latest information in all cases; and too frequently his definitions show haste or carelessness in their wording. The illustrations also are for the most part rather ancient and not always such as to justify their insertion in a work of this nature.

Notes & Queries

HINTS TO CORRESPONDENTS.

No attention will be paid to communications unless accompanied with the full name and address of the writer.

Names and addresses of correspondents will not be given to inquirers.

We renew our request that correspondents, in referring to former answers or articles, will be kind enough to name the date of the paper and the page, or the number of the question.

Correspondents whose inquiries do not appear after a reasonable time should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them.

Persons desiring special information which is purely of a personal character, and not of general interest, should remit from $1 to $5, according to the subject, as we cannot be expected to spend time and labor to obtain such information without remuneration.

Any numbers of the SCIENTIFIC AMERICAN SUPPLEMENT referred to in these columns may be had at this office. Price 10 cents each.

(1) C. T. W. asks: 1. Can paper be subjected to any chemical process so as to change color by the impact of any hard substance, and thus give impressions of coins or seals without the intervention of ink or coloring matter? A. As we understand you, no. 2. Has any successful attempt ever been made to obtain lithographic copies of the original writing or drawing without transferring to the stone, by the use of artificially prepared paper? A. Your question is rather ambiguous. There are several autolithographic and photolithographic processes in successful use. Consult the back numbers of the SCIENTIFIC AMERICAN and the records of the Patent Office. 3. Is there any prepared oil or varnish by which paper can be rendered impervious to water and still be capable of receiving ink, so as to, in a measure, take the place of the lithographic stone? A. We believe no practical success has been achieved in this direction.

(2) C. writes: A serious fire just took place in a large hotel heated by steam and having electric bells, annunciators, etc. In the room where fire originated between the flooring, a large bunch of bell wires run, also steam and gas pipes, chimney in room also. The proprietors claim there has been a gas leak in room, under flooring, a long time. During the afternoon the bell indicating that room rung at intervals from some unknown cause (fire occurred in evening). The general belief is, that fire originated from spark of two wires coming in contact (insulation eaten off) igniting the escaping gas. Now, is it possible for such a contingency, with only four Leclanche batteries in circuit? Isn't it more probable fire took from steam pipes coming in contact with woodwork? A short circuit from same batteries, even from 12 elements, would not light gas at a burner without an induction coil by experiment. A. It rarely happens that a fire is caused by the contact of steam pipes with woodwork. When it does occur it is generally traceable to some highly inflammable substance accumulated around the pipe. If there was a considerable gas leak, the fire might have been communicated from the chimney, or from a distant gas flame. It is also quite possible that it might have been ignited by an electric spark, if the wires could have been brought into contact by any means. In your experiment you seem to have forgotten that the helices of an electro-magnet are really induction coils from which a spark may be obtained with small battery power whenever the circuit is broken.

(3) G. F. W. asks: What material will mix with an oil filling for wood, and stain the wood black or nearly so? A. Boettger recommends the use of the vegetable fuel contained in the anacardium nut in this connection. The oily matters are obtained from the crushed nuts by means of petroleum spirit or bisulphide of carbon.

(4) S. W. F. writes: I am having made a spiral vane as described in your reference book. The spiral is made of thin sheet copper, such as tinners use for boilers, etc. Can I cement the mica or small pieces of looking glass to the spiral so that it will stand the weather and stay on? A. Melt together in an iron pan over a moderate fire pitch and gutta percha, in about equal parts, and add to the mixture about 10 per cent of shellac. Use hot, warming the parts to be joined, and avoiding the use of too much cement in the joint.

(5) E. R. asks how to make a small induction coil such as is used with the Blake transmitter. A. Make a thin wooden spool 3 inches long, ⅜ inch internal diameter. Fill the hole through the spool with a bundle of No 20 iron wires well straightened. Wind on the spool 4 layers of No. 20 silk covered copper wire. This is the primary wire, which is connected with the battery and transmitter. Cover the primary coil with paraffine paper, and wind on it six or eight courses of No. 38 or No. 40 silk covered copper wire. The ends of this coil are connected with the line which includes the receiving telephones.

(6) A E.—Phosphor-bronze contains 90 to 91 per cent of copper and 9 to 10 per cent of tin. The proportion of phosphorus added is about ½ of one per cent. The phosphorus imparts greater fluidity to the metal in the crucible and greater strength and elasticity, etc., to the castings.

(7) W. N. W. writes: 1. In "Hints to the Young Steam Fitter," page 355, third column near bottom—S. A., December 6—the writer says: "But the maximum pressure of steam to be carried must never exceed the equivalent of a difference in level of water between the water line of the boiler and the lowest part of the distributing main." I would like to ask him why, and what difference it can make whether you carry one pound of steam or three? A. Mr. Baldwin has furnished us with the following: The words mentioned apply to low pressure gravity apparatus, as they usually exist, the distributing mains being of size barely sufficient to expel the air from the radiators furthest from the boiler, when a mercury column or good low-pressure steam gauge will often show 2 or 3 lb. at the boiler. Thus at the part of the distributing main furthest from the boiler, we will say a gauge will show ½ lb pressure and at the boiler 3 lb., the reason of the difference is, we are dealing with an elastic and condensable fluid, of tension so low that its velocity is not great enough to keep a nearly initial pressure throughout the system above the water Now, again, put a gauge on the boiler at the water line, and it will show 3 lb. pressure also. Again, tap into the return relief at the same level, and it will show 3 lb. Why? because we are dealing with a fluid that has no practical elasticity and will raise in a pipe 2¼ feet (very nearly) for every pound of difference between terminal and initial pressures, and this head of water will rise into the main unless it is high enough above it. I wish also to call inquirers' attention to page 356, No. 23, S. A., where it says: "To have the water of condensation return directly into the boiler under all conditions and pressures, the main pipes must be large enough to maintain the pressure of the boiler to within 1 or 1½ lb. in every part of the apparatus." 2. I would also like to ask him to make a little plainer his rule for calculating size for steam mains. A. The areas of the cross section of pipes are to each other as the squares of their diameters. Thus if the size of a one inch pipe in the main at the boiler is enough for 100 square feet of heating surface, a 4 inch pipe will do for 1,600 square feet. Thus square of $1=1$. Square $4=16\div1=16$ hundred square feet, or if you have the heating surface, and want to find the size of main, take 1-10 (one tenth) the square root of the heating surface in feet, and it gives the diameter of the pipe in inches.

(8) W. H. writes: I have a steam job to do in a store. Two of the radiators are forty feet from the boiler, and there is no cellar underneath for that distance. The joist lay on the ground. I have taken out a trench and placed my pipes in it, and made it ten inches lower at the connection on the main distributing pipe than that at the radiators, and run the return the same way. So you see the water in the supply pipe running against the steam. I do not see any other way to do. Am I right? A. If the distributing main is ample, and the pipe in trench large enough, it will answer; but should these two radiators give trouble and act differently from the other radiators in the job, take their steam pipe directly to the boiler.

(9) C. C. asks: 1. Why does a ball rise above the direction in which it is shot from a gun? A. We think this could not happen with a rifle, and it would not be likely to occur with a smooth bore, except with an imperfect ball. 2. When a balloon is above all obstructions, and has no other motor than the wind, will it go faster than the wind that moves it? A. No. 3. If we run a locomotive on a level road, two miles in two minutes, will there not be more friction than if we ran it one mile in two minutes? A. In the aggregate for time, yes; for distance, no.

(10) H. N. asks: 1. Has a locomotive with low drive wheels more power of traction than it would have if the circumference of the wheels were larger? If so, why? A. Yes, other things being equal, because the pressure on the piston has greater leverage on the point of resistance, the radius of the wheel. 2. Of what particular use is the vacuum to the marine or condensing engine? A. To remove the pressure of the atmosphere from behind the piston.

(11) W. S. W. writes: I have a well, 7 feet in diameter: shall I, by multiplying $3{\cdot}1416\times7$, get the circumference of the well? A. Multiply 3·1416 by the diameter, the product is the circumference. 2. What will I divide by to find out how many cubic feet in 1 foot? A. To get the contents multiply the diameter by 0·7854, and the product by the length of the column—all in inches—the final result is cubic inches. You should study some good elementary work on mechanics.

(12) C. H. B. writes: In your issue of September 27, page 204 (No. 24), you say that a 4 inch solid pillar will support more weight than a 4 inch hollow pillar. A. Your former question was simply whether a solid or hollow pillar of a given diameter would carry the greatest load; the answer was correct. 2. Now, suppose two pillars to contain the same amount of material, one being cast solid, the other hollow, which will sustain the greatest weight? A. The hollow pillar will be the strongest in this case, and the larger the diameter the better, so long as the thickness is sufficient to insure sound castings.

(13) E. I. asks: 1. What is caking coal? A. Soft bituminous coal that cakes in a fire. 2. How are Hessian crucibles made? A. See p. 267 (6), Vol. 39, of SCIENTIFIC AMERICAN, for the details of crucible making. 3. How many feet in one pound No. 16 copper wire? A. About 80 feet, by Birmingham W. G., and 137 feet, by American W. G.

(14) F. D writes: I have a telegraph line about a mile in length running into my room. The ground connection is made by means of the gas pipe. The wire used inside of the house is all insulated, and the line wire is one or two sizes smaller than is usually used. I have 3 jars of gravity battery. Is there any danger from lightning? A. If you use a lightning arrester and connect your ground wire with the gas pipe outside of the meter there is no danger.

(15) O. E. P. writes: Referring to "Notes and Queries" in SCIENTIFIC AMERICAN, p. 417 (20), last volume, A. C. says he can't dissolve bleached shellac in alcohol for varnish; you suggest that he has not pure alcohol. I have had considerable trouble with making varnish from bleached shellac, and I find there is more likely to be trouble from adulterated shellac than poor alcohol. In this city (Richmond, Va.), it is impossible to get bleached shellac which has less than 30 per cent of adulteration. With 95 per cent alcohol the varnish made with this will be curdy in the middle, alcoholic solution at the top, and a dirty whitish powder at the bottom. I would suggest that A. C. try some other shellac, and bruise in small pieces before adding the alcohol, and set it where it will be warm, say 70° Fah. If the shellac and alcohol are both good, he ought to have his varnish ready for use in from 24 to 36 hours.

(16) W. J. says that wood sawing is rendered much easier by occasionally oiling the saw with kerosene.

(17) J. E. B. asks: How much horse power can be obtained from a stream of water 40 feet head flowing through a 4 inch pipe and employing a common turbine wheel? A. Allowing for friction, etc., from 1½ to 2 horse power.

(18) F. P. asks what length and diameter of screw would be required to propel a sharp built boat of twenty feet. A. 20 inch diameter, 30 to 36 inch pitch, and 5 to 6 inches length.

(19) D. M. asks: Can stone houses be built in any way to be free from dampness? A. If the walls are properly furred and the spaces between the furring and the wall are ventilated, dampness may be avoided.

(20) J. A. B. asks whether emery or corundum wheels or stone can be used for the expeditious grinding of round bottles into shape for sulphide of carbon prisms. A. Use square bottles, grind them upon the flat side of an iron disk supplied with fine sharp sand and water.

(21) S. J. M. asks for a reliable method of cleaning kid gloves. A. Put them together with a sufficient quantity of pure benzine in a large stoppered vessel, and shake the whole occasionally with alternate rest. If on removing the gloves there remain any spots, rub them out with a soft cloth moistened with ether or benzole. Dry the gloves by exposure to the air, and then place smoothly between glass plates at the temperature of boiling water until the last traces of benzine are expelled. They may then be folded and pressed between paper with a warm iron. Another way is to use a strong solution of pure soap in hot milk beaten up with the yolk of one egg to a pint of the solution. Put the glove on the hand and rub it gently with the paste, to which a little ether may be added, then carefully lay by to dry. White gloves are not discolored by this treatment, and the leather will be made thereby clean and soft as when new.

(22) M. W. asks: How can I cement parchment so that it will stand both hot and cold water? A. Mix ordinary glue with about 3 per cent of potassium or ammonium dichromate in the dark. This may be used on the paper, and after exposure to light becomes perfectly insoluble in boiling water. This glue has been very largely used in Germany for joining the parchment paper envelopes of pea sausages. The strips of paper joined by this glue are dried quickly and exposed to light till the glue changes to a brownish color; they are then boiled with water containing about 3 per cent of alum till all the excess of alkaline dichromate is extracted, and then washed in water and dried.

MINERALS, ETC.—Specimens have been received from the following correspondents, and examined, with the results stated:

A. T. S.—The mineral is marcasite, iron sulphide, in a quartz matrix. It is not indicative of anything valuable.

COMMUNICATIONS RECEIVED.

On Ship Railway. By F. M. O.
On Crystallization of Bodies. By T. W. S.
On the Origin of Coals and Ores. By R. B.
On Ice Boats. By G. M. R.
On Some Pre-Historic Bones. By C. H. S.
On Ice Boats. By H. J. T. and W. B. M.
On Ice Yachts Sailing Faster than the Wind. By F. S. C. and F. K. S.
On Steam Jet Signals. By F. P.
What is Good Silk? By L. L.
On Electrical Generators. By S. W. R.

[OFFICIAL.]

INDEX OF INVENTIONS

FOR WHICH

Letters Patent of the United States were Granted in the Week Ending December 9, 1879, AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

A complete copy of any patent in the annexed list, including both the specifications and drawings, or any patent issued since 1867, will be furnished from this office for one dollar. In ordering please state the number and date of the patent desired, and remit to Munn & Co., 37 Park Row, New York city.

Air heater, J. T. Greenwood	222,395
Air heating attachment, J. M. Patterson	222,528
Animal trap, C. Marti	222,520
Antiseptic and deodorizing compound, M. Burchard	222,451
Bag, A. Smith	222,425
Bedstead, folding, S. S. Burr	222,379
Beer cooler, F. Heller	222,495
Beer, manufacture of, E. Kokosinski	222,507
Belt, L. Aarons	222,434
Belt fastener, C. W. Sager	222,535
Belting, machine for making rubber, J. Murphy	222,524
Bicycle, S. Sawyer	222,537
Blacksmith's tool, L. C. Derry	222,470
Blind fastener, window, W. H. B. Allen	222,435
Book, copy, J. W. C. Gilman	222,349, 222,350
Bridge, B. Houts	222,499
Bridge and turn-table, turn, D. Blanchard	222,375
Buggy top, J. H. & E. M. Keller (r)	8,989
Burglar alarm, A. J. Ridgeway	222,533
Button card, G. P. Farmer	222,482
Button or stud, separable, F. P. Barney	222,441
Button, separable, A. R. Leedner	222,356
Can tops, etc., die for cutting, J. W. Farrell	222,481
Car coupling, J. M. Van Why	222,551
Car jack, J. J. Hamilton	222,402
Car window, W. W. Mackall, Jr.	222,518
Carpet lining and stair pad, M. Townsend	222,370
Carriage brake, baby, W. F. Wallberg	222,552
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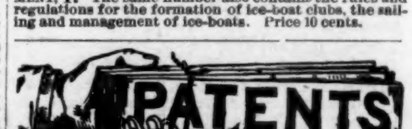

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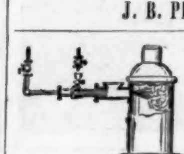

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